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Architects' Blueprints and Specifications

103 ILLUSTRATIONS

By

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READING ARCHITECTS' BLUEPRINTS
SPECIFICATION WRITING
SPECIFICATION WRITING MEMORANDA

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PREFACE

The volumes of the International Library of Technology are made up of Instruction Papers, or Sections, comprising the various courses of instruction for students of the International Correspondence Schools. The original manuscripts are prepared by persons thoroughly qualified both technically and by experience to write with authority, and in many cases they are regularly employed elsewhere in practical work as experts. The manuscripts are then carefully edited to make them suitable for correspondence instruction. The Instruction Papers are written clearly and in the simplest language possible, so as to make them readily understood by all students. Necessary technical expressions are clearly explained when introduced.

The great majority of our students wish to prepare themselves for advancement in their vocations or to qualify for more congenial occupations. Usually they are employed and able to devote only a few hours a day to study. Therefore every effort must be made to give them practical and accurate information in clear and concise form and to make this information include all of the essentials but none of the non-essentials. To make the text clear, illustrations are used freely. These illustrations are especially made by our own Illustrating Department in order to adapt them fully to the requirements of the text.

In the table of contents that immediately follows are given the titles of the Sections included in this volume, and under each title are listed the main topics discussed.

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READING ARCHITECTS' BLUEPRINTS

(PART 1)

DRAWINGS, BLUEPRINTS, AND SPECIFICATIONS

INTRODUCTION

1. Definition of a Drawing.—A *drawing* is a series of lines, marks, symbols, letters, and figures, made on paper or cloth for the purpose of showing the design, arrangement of parts, and size of a building or any object. In the case of a building, several drawings are required to represent it completely.

2. Definition of a Blueprint.—A *blueprint* is a print made upon sensitized paper from a drawing that has been made on transparent paper or cloth. A sheet of paper coated with a substance sensitive to light is placed against the paper or cloth upon which the drawing has been made, in a suitable frame under a sheet of glass. Sunlight or strong artificial light is then allowed to act upon the sensitized paper through the drawing. When the sensitized paper has been exposed for a sufficient time, it is removed from the frame and thoroughly washed in clear water. The parts covered by the opaque lines of the drawing become white, and the remaining parts become blue.

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3. Object of Making Blueprints.—Drawings must be made by the architect or his draftsmen, and considerable time is required to produce them. They are, therefore, comparatively expensive. It is advantageous to have several copies of the drawings that are made for any building, so that estimators, contractors, foremen, and others may have separate copies. Consequently, the original drawings are traced upon transparent paper or cloth. These drawings are called *tracings,* and any number of prints can be made from them without injuring the tracings. The tracings are generally filed in suitable cases or drawers in the architect's office, and prints can be made from them at any time. The process of making blueprints is inexpensive when compared with that of making drawings or tracings. Every mark shown on the tracings is faithfully reproduced on the blueprint, and for this reason the use of the blueprint accomplishes the same result as if the original drawings were used.

4. Importance of an Understanding of Drawings. The drawings and blueprints made by the architect must be used by the contractors, the foremen, and the dealers who supply the materials employed in the construction of the building. Hence it is important that such persons should thoroughly understand the drawings and be able to interpret all lines, marks, symbols, and letters found on them.

5. The contractor or the estimator employed by the contractor, must thoroughly understand the drawings, as it is his function mentally to resolve the building into its component parts, and to make complete and exact lists of all the materials that are required for its construction.

6. The foreman represents the contractor at the building, and has charge of its erection. He must be competent to take all the materials delivered at the building site and put them together according to the drawings. Any mistakes that he may make in interpreting the drawings may prove very costly to the contractor, who must pay the cost of correcting them.

7. A dealer who supplies cut stone, brick, lumber, hardware or other materials for a building is often called upon to make estimates for furnishing such material. To do this intelligently he must be able to determine from the drawings just where and in what quantities his materials are to be used, and this requires ability to read the drawings.

8. The indications used on architects' drawings are really a special language used to convey facts and ideas necessary for the construction of a building, and they should be thoroughly understood by all those that supervise and direct such work.

9. Definition of a Specification.—A *specification* is a detailed description of the character and quality of the workmanship and materials that are to be used in a building. The collection of all the specifications for any one building is known as the *specifications,* or *set of specifications.* The specifications include information that cannot be shown graphically on the drawings.

10. Relation Between Drawings and Specifications.—It is evident that many of the architect's ideas, as for instance, those in connection with painting and decoration, hardware, plaster work, the finish of woodwork, qualities of materials, and methods of operation, cannot be shown on the drawings. Consequently, the specifications are a necessary supplement to the drawings, and the drawings and specifications should, taken together, furnish all the information requisite for the erection and completion of the building. Incompleteness in the drawings and specifications gives rise to most of the disagreements and misunderstandings that occur between the owner and the contractor, and between the architect and the owner.

11. Some architects make many notations on drawings which belong more properly in the specifications. When such notations are put on drawings the contractor is apt to be misled by them. Thus, "oak flooring" might be marked on the drawings, whereas the specifications might call for "quarter-sawed white-oak flooring." Unless the contractor compares the two

notations carefully, a mistake is apt to to be made in the materials ordered or furnished. Complete descriptions belong in the specifications, and it is not wise to write partial specifications on the drawings.

DRAWINGS USED TO REPRESENT BUILDINGS

12. The drawings generally used to represent buildings are *elevations, plans, sections, scale details,* and *full-size details.* For very small and simple buildings, the elevations, plans, and sections are often sufficient for estimating the cost of materials and for erecting the building. In more elaborate structures, elevations, plans, and sections are given to the contractor for use in estimating the cost of the building, and scale details and full-size details are given, in addition, to assist him in erecting the building. The contractor frequently prepares special drawings, known as *shop drawings,* which he uses in preparing and erecting his particular work.

Accompanying this Section is a set of blueprints of a moderate-sized residence. This consists of four elevations, four floor plans, and two sections. On these prints will be found examples of the practical application of many of the details that are shown in the illustrations accompanying the descriptions here given.

A clear understanding of how the different indications mentioned in the text will appear on working drawings can be obtained by referring to the place on the blueprints where the object, material, or construction mentioned appears.

13. Elevations.—Elevations are drawings that show the exterior of a building in its true proportions, but usually at a smaller size. The drawing of the front of a building is called the *front elevation;* that of the side that is on the right of a person facing the front of the building is called the *right-side elevation;* that on the left is called the *left-side elevation,* and the drawing of the rear is called the *rear elevation.*

According to whether these elevations are to be toward the north, east, south, or west, they are sometimes marked *north elevation, east elevation,* etc. The north elevation is the north-

erly side of the building, etc. The elevations accompanying this Section are marked North, East, South and West, respectively.

The purpose of the elevations is to show the appearance of the exterior of the finished building, and on them are usually found various indications of materials used for constructing the exterior of the building, indications of floor lines and levels, dimensions, such as story heights and sizes of the sash.

14. Plans.—The terms *plans, set of plans, working drawings, general drawings,* etc., are frequently used to refer to all the drawings that are prepared for the construction of the building. When used in this sense, these terms refer to and include all the floor plans, elevations, sections, and often the details of the building.

Strictly speaking, however, a plan is a horizontal section through the building, showing the arrangement of the parts of one floor, and is often called a *floor plan.* These plans are drawn in their true proportions and of small size, such, for example, as $\frac{1}{4}$ inch = 1 foot. A plan is generally made of each floor, and each plan is named from the floor that it shows. Thus, the plan of the first floor is designated the *First Floor Plan;* of the basement, the *Basement Plan;* of the attic, the *Attic Plan.* Separate plans are sometimes made for the foundation and for the roof, but more generally the lines of the foundation are shown on the basement plan, while the lines of the roof are shown on the attic plan. Plans of the basement, first floor, second floor, and third floor, or attic, accompany this Section.

15. Floor plans show the arrangement and location of walls, partitions, closets, dressers, fireplaces, windows, doors, and other parts of the building, as well as indications of the materials of which certain parts are constructed. They also show the location of various devices, such as plumbing fixtures, lighting outlets, and heating apparatus. Such devices are shown in approximate location only, and the specifications describe them in character and detail. Their exact location will be fixed after the building is erected and the walls and partitions are in place.

16. In some cases the architect indicates the location of such equipment as gas stoves, ranges, laundry stoves, hot-water

heaters, refrigerators, bookcases, and other furniture not necessarily attached to or built into the building, in order to show where they may be placed, or to indicate to the contractor where connections are to be made. When such furniture or equipment is shown on the plans, it should be particularly stated either on

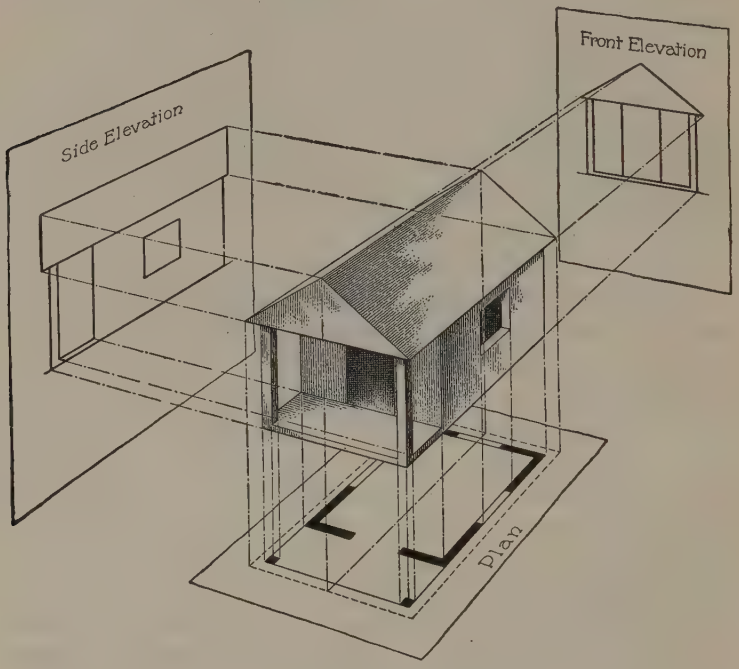


FIG. 1

the plans or in the specifications whether or not such fixtures are to be furnished, and by whom.

17. Relation of Plans to Elevations.—It is impossible to show all of a building properly either on plans alone or on elevations alone. It is, therefore, necessary to have both plans and elevations. Further, it is impossible to show all of the design on one elevation, it being necessary to show an elevation of each side of the building. This fact is illustrated in Fig. 1, which represents a small building. It is evident that while the plan shows the actual area covered, it indicates very little of the

design shown on the elevations. As the front elevation gives very little indication of what appears on the sides, it is necessary to have a plan and also elevations of all the sides of the building in order that all of the design may be shown. The plan, shown in Fig. 1, gives no indication of the height of the building, but the height is plainly seen on the elevations. On the other hand, the depth of a house, or the distance from front to back, cannot be determined from the front elevation alone, although from the plan an exact idea may be obtained. Likewise, the side elevation gives no indication of the width of the building, but this is clearly shown on the plan and on the front elevation. Elevations show the building without regard to the distance of any of the parts from the eye, and one is unable to determine from them how far back any part may be. Thus, in the front elevation, the door is the depth of the porch back from the front of the porch, but this distance is not indicated on the front elevation. It shows plainly, however, on the plan and on the side elevation. From this example will be seen the necessity for the plans and the several elevations.

18. Dimensions.—Every floor plan should be carefully dimensioned, as the principal dimensions of the building occur on such plans. Dimensions are especially important on the cellar or basement plan, since the accurate construction of the upper part of the building depends largely upon the care with which the cellar walls are laid out. The total lengths of the walls of the building should be given, particularly on the basement plan. How such dimensions are placed will be seen by reference to the accompanying blueprint entitled Basement Plan. There the overall length of the front wall of the main building is shown to be 44′ 0″ (44 feet 0 inches); the depth of the building, as shown on the right-hand side of the plan, is 43′ 0″, and the length of the rear extension wall is 29′ 6″.

These total, or overall, dimensions on the basement plan are of the greatest value in laying out the lines for excavating for the foundation walls. In the upper floors they are useful in estimating quantities of materials used in various parts of the work.

These overall dimensions are divided into smaller dimensions, as shown on the blueprints, such as those from the ends of walls to centers of windows, pilasters, etc. In the case of walls built of masonry, the dimensions are taken from the finished outside face of the wall. In the case of frame buildings, the dimensions are generally taken from the outside of the sheathing, if sheathing is used. In some cases, however, the dimensions are taken from the outside faces of the studs. The methods of dimensioning plans will be further discussed in connection with plans of buildings given later on.

Dimensions should also be given for the interior of the building, the dimensions being taken to the centers of partitions and to the outside of masonry walls, or to the face of the studding of frame walls, as illustrated in the blueprint entitled Second Floor Plan. The height of stories, windows, and other vertical heights are shown in the elevations and sections, and are given with relation to the finished floor lines or to the top lines of the floor joists.

In marking the locations of windows, doors, and other openings on the plans of frame buildings it is customary to give the dimensions to the centers of the openings. On plans of masonry buildings it is usual to give the dimensions to the sides of the openings rather than to the centers. Thus, with brick walls, the dimensions show not only the length of the walls between the windows, but the actual brick openings for the windows and doors. Careful study should be given to the methods of dimensioning used upon the accompanying blueprints.

19. Hidden Construction.—There are many places on drawings where work is indicated, although actually it would not be seen. This is for the assistance of the workmen and others who wish to see the relation between the work actually shown on the drawings and other parts related to it, but which ordinarily would not be shown on the drawing. Thus, in the blueprint entitled South Elevation are indicated the locations of the footings for the foundation walls at *a*, the bottoms of the dwarf walls for porches and areas at *b*, and the basement sash below grade at *c*. These lines, indicating work not in

plain view, are shown dotted or broken. In this elevation are also shown the finished floor lines *d*, indicated by dot-and-dash lines, extending out to a line of dimensions showing the distances from floor to floor. In the Basement Plan at each side of the wall *a* are seen the broken lines indicating the footings for the walls, and at *b* is shown a concrete pier below the floor line.

In the First Floor Plan at *a* is shown an opening containing two columns and dotted lines extending across the opening. The dotted lines represent the work above the plane at which the remainder of the plan is taken, and indicate that the partition is carried across the tops of the columns. While these features may be shown in other drawings, their indication at these places shows their relation to the other parts of the building. The labor of drawing a complete additional plan or section is thereby obviated and the workman is saved the trouble of comparing a number of drawings to get the necessary information.

20. Framing Plans.—While the architect prepares the general plans to show the arrangement of rooms, walls, windows, doors, and other parts of the building, he must also provide for the construction to be used. The framing construction is seldom shown on the general plans, yet the architect must carefully consider that work. In other words, there is an implied construction which must be considered in the preparation of all plans. Thus, a frame building must have joists, studs, rafters, framing for stairs, doors and windows, etc. Although this work may not be actually shown, the architect must provide room for its installation. In like manner, the piping for plumbing and heating, wires for lighting, etc., must be provided for in the planning of the building, although none of it may show on the general plans.

A wall consisting of studs, stucco, and plaster, as at *b* in the First Floor Plan, is represented by inside and outside lines only, as the construction is generally specified. These lines, however, must be drawn the proper distances apart to provide for the construction required by the architect.

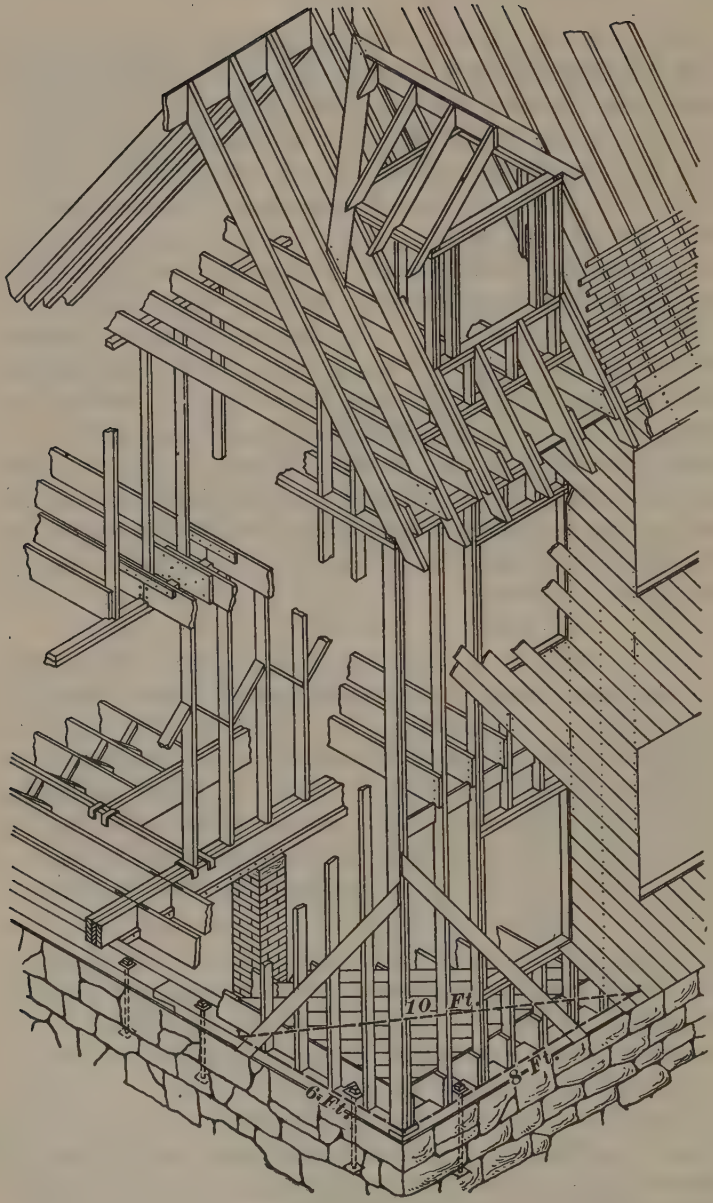


FIG. 2

21. It was formerly the practice for the architect to make a framing plan of each floor and the roof, as well as a framing elevation for each of the outside walls. These drawings showed accurately the arrangement of studs in the wall and the framing around the doors and windows. The drawings also gave the arrangement of floor joists, framing of stair wells, around chimneys, etc. These drawings taken together were generally known as *framing plans.* This practice is not generally followed now, as the methods of installing or erecting the framing are according to established customs or methods. Instead of the architect preparing such drawings, the contractor or his foreman is usually expected to lay out whatever framing plans he may require. As shown on the blueprints, the architect usually indicates the direction of the joists in the floor by arrows; also the size and spacing of the joists.

In Fig. 2 is a perspective diagram of the framing of a building similar to the one shown in the blueprints; in this diagram can be seen the construction that is not shown, but is implied, in the general plans.

22. Sections.—Sections are drawings that show how a building would appear if it were cut vertically from roof to cellar by a huge knife or saw, and the interior of either part were shown. A section that is taken in a direction parallel to the front of the building is sometimes called a *transverse section.* A section taken perpendicular to the front of the building is sometimes called a *longitudinal section.* In other cases, the section taken in the direction of the greatest length of the building is marked the longitudinal section, and the section taken at right angles to the longitudinal section is called the transverse section. Sections are not always taken in one plane, but are often taken along a line marked on the floor plans with letters, as *A-B* or *C-D* in the blueprints of the plans. The object of doing this is to show the most important parts of the building in one section, and to avoid making any more sections than are absolutely required. Thus, the transverse section shown in the blueprint is taken on the line *A-B* in the floor plans. This section shows a view of those portions of the building which

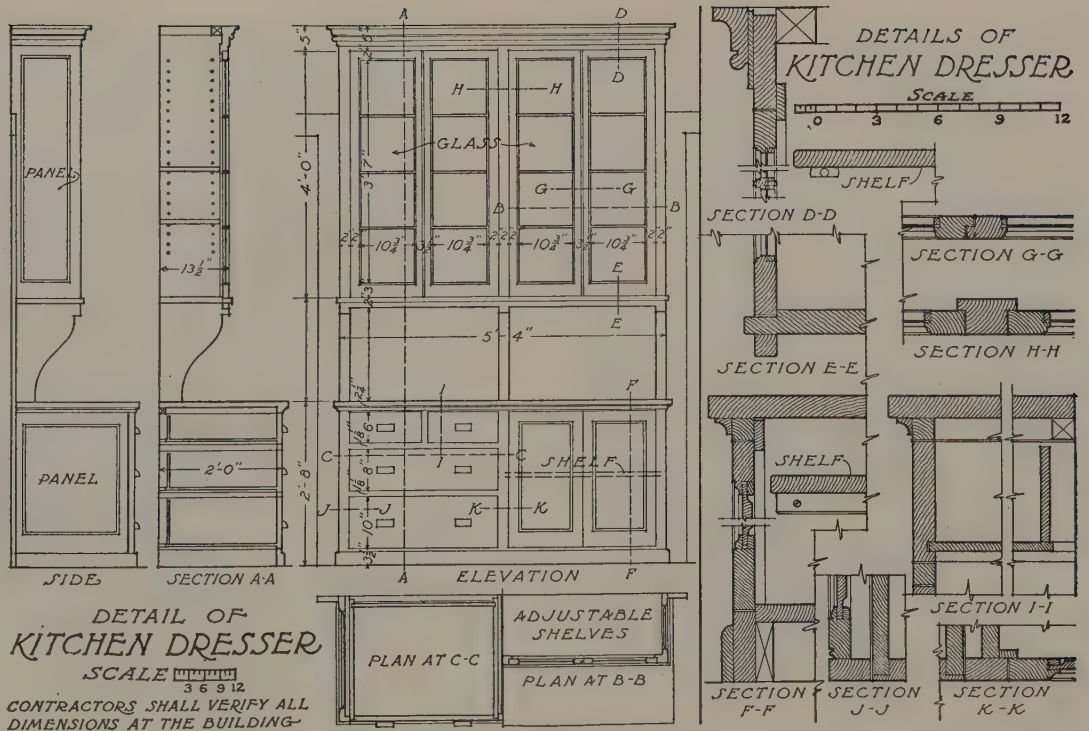
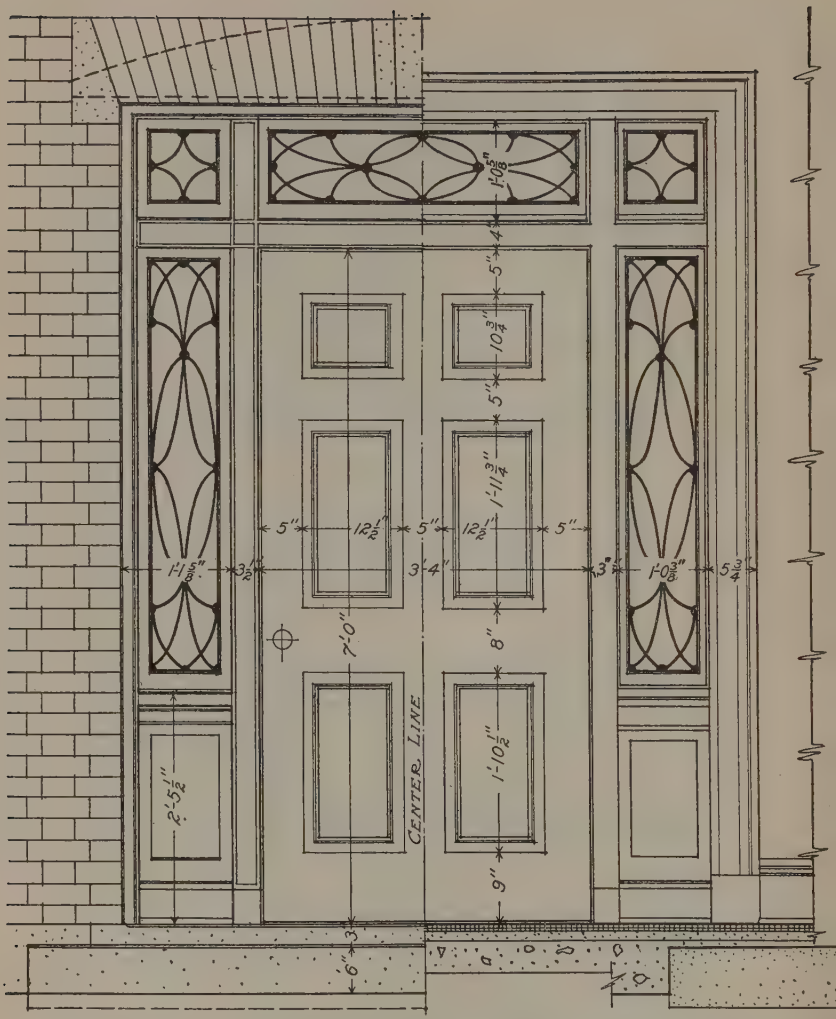
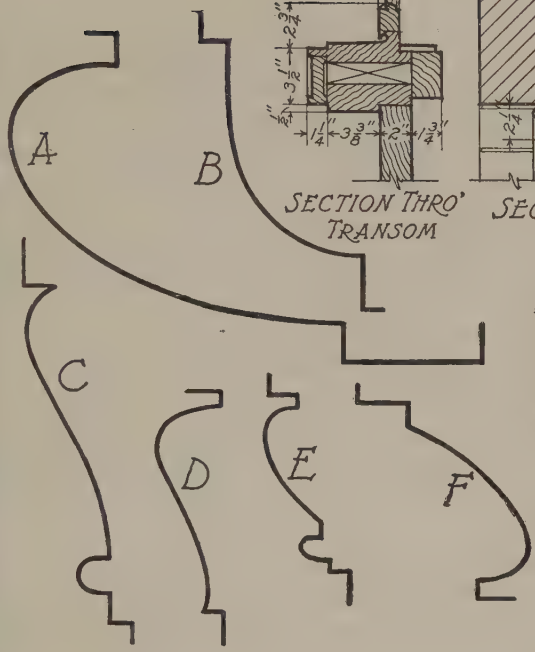

DETAIL OF
KITCHEN DRESSER
SCALE
3 6 9 12
CONTRACTORS SHALL VERIFY ALL
DIMENSIONS AT THE BUILDING
PANEL
PANEL
SIDE
SECTION A-A
ELEVATION
GLASS
SHELF
ADJUSTABLE
SHELVES
PLAN AT C-C
PLAN AT B-B
DETAILS OF
KITCHEN DRESSER
SCALE
0 3 6 9 12
SHELF
SECTION D-D
SECTION G-G
SECTION E-E
SECTION H-H
SHELF
SECTION I-I
SECTION
F-F
SECTION
J-J
SECTION
K-K

FIG. 3

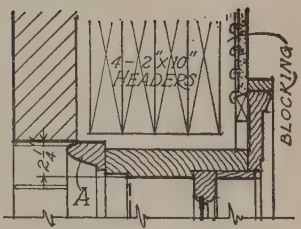

1'-10⅝"
5"
10¾"
5"
1'-11¾"
5"
12½"
5"
12½"
5"
1'-1 5/8"
3½"
3'-4"
3"
1'-0 3/8"
5¾"
7'-0"
8"
CENTER LINE
2'-5½"
1'-10½"
9"
6'-3"
ONE HALF EXTERIOR
ONE HALF INTERIOR
ELEVATION
3¼"
13"
1'-5⅛"
1'-8"
PLAN
ENTRANCE
IN BRIC

ILT 263. 448 § 5

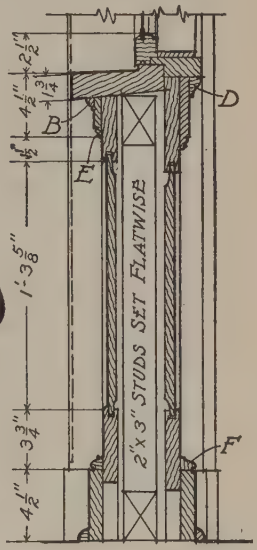




SECTION THRO' TRANSOM



SECTION THRO' HEAD



SECTION THRO' WINDOW SILL

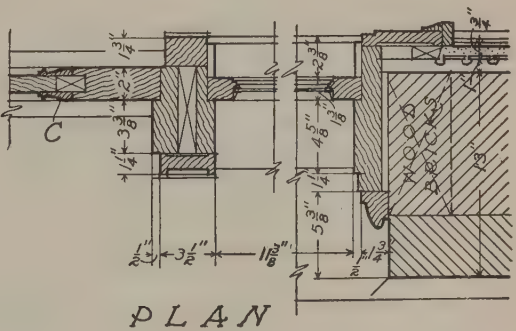
SCALE

FOR ELEVATIONS, SECTION AND PLAN
ONE HALF INCH EQUALS ONE FOOT.
FOR DETAIL SECTIONS AND PLAN
ONE INCH EQUALS ONE FOOT.
PROFILES OF MOLDINGS FULL SIZE.

TION

OORWAY

WALL



PLAN

would be seen by a person looking in the direction of the arrow points at *A* and *B*, if the portions in front of the section line were removed. Likewise, the blueprint of the longitudinal section shows a section of the building taken on the line *C-D*, and showing those portions of the building seen by a person looking in the direction of the arrow points at *C* and *D*.

23. Scale Details.—While the accompanying set of blueprints shows in a general way the construction of the building, there are certain portions of the building that must be shown in greater detail, so that their construction and design may be understood. Drawings at a larger size and scale are therefore made and are called *scale details*. These details consist generally of plans, elevations, and sections of the portion of the building detailed, drawn at a much larger scale than is used in the general plans. These details are made 1/24, 1/16, 1/12, and even 1/4 of the actual sizes of the parts shown. By showing them at these sizes, the details of construction, moldings, and ornaments can be more clearly shown, so as to be plain to the mechanics who are to work from the drawings. A **scale detail** may, therefore, be defined as a drawing which shows a portion of a building at from 1/24 to 1/4 of its actual size, for the purpose of showing clearly the elementary parts and the construction of that portion. Examples of scale details are shown in Figs. 3 and 4.

24. Full-Size Details.—Full-size details are drawings that are made to show portions of a building at their actual size. The scale details show the general arrangement of portions of the building that may need to be shown at a larger scale than the general plans, but profiles of moldings, sections through trim, sash, and ornamental work, cannot be shown clearly at these scales; therefore, these indications are elaborated in the full-size details, and are drawn to actual size. Without these full-size explanatory drawings, the scale details would be incomplete. Examples of full-size details are given in Fig. 4.

25. It frequently happens that one sheet of drawings will contain drawings at different scales. Thus, a drawing showing

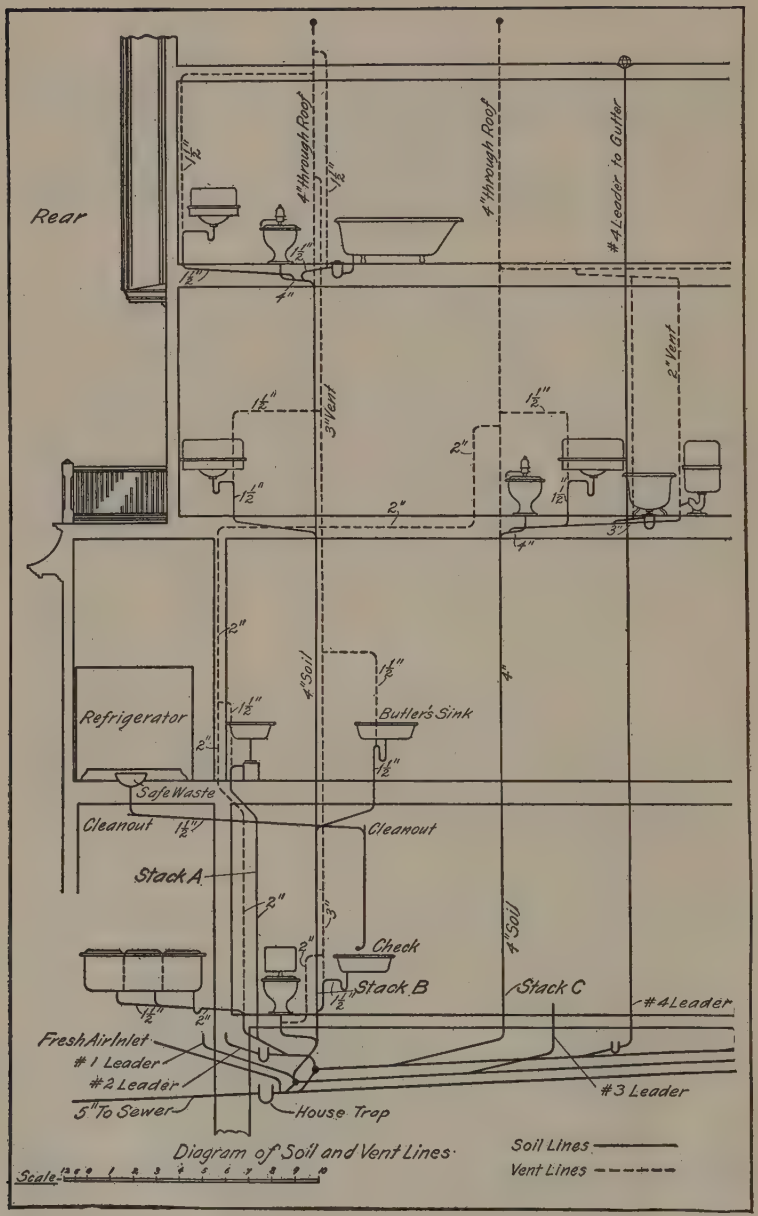

Rear
4" Through Roof
4" Through Roof
#4 Leader to Gutter
2" Vent
3" Vent
4" Soil
4" Soil
Refrigerator
Butler's Sink
Safe Waste
Cleanout
Cleanout
Stack A
Check
Stack B
Stack C
#4 Leader
Fresh Air Inlet
#1 Leader
#2 Leader
#3 Leader
5" To Sewer
House Trap
Diagram of Soil and Vent Lines
Soil Lines
Vent Lines
Scale

FIG. 5

the general construction of a doorway, as Fig. 4, may be drawn to one scale, while some of the details may be drawn to a much larger scale, and the profiles may be full size. Full-size drawings are not always dimensioned, as it is possible to measure the lines with accuracy with the scale or rule.

26. Plumbing Section.—Building Departments in some cities require that a plumbing section be filed before a building permit will be issued. A plumbing section shows the general arrangement of all the plumbing fixtures and their connection to the main sewer by means of the soil lines. A plumbing section is seldom drawn to scale, as it is intended to show the number of fixtures and their arrangement only. In Fig. 5 is shown a portion of a plumbing section of a building having fixtures in the basement, and on the first, second, and third floors.

The plumbing section, as will be noted, contains no dimensions, and is not drawn accurately to scale or in proportion, as the work will be installed in the spaces provided, and in accordance with the requirements of the fixtures. The fixtures are fully described in the specifications, and indicated on the plans.

27. Shop Drawings.—Besides using the architect's drawings, the contractors for such work as the terra cotta, stone, millwork, steel, sheet metal, and heating, prepare special drawings, called *shop drawings*, to be used in constructing their part of the work. In general, these drawings conform to the architect's drawings of the finished work, but they show the special methods of construction used in connection with the various trades. These drawings are usually submitted to the architect for his approval before the work shown on them is begun. Such drawings must be checked carefully by the architect, to insure that they conform to his drawings, and that they do not interfere with the work of other trades, or with shop drawings already approved. When the architect marks these shop drawings *Approved* they become authoritative plans which must be followed in the execution of the work.

In Fig. 6 is shown an example of a shop drawing for an iron stairway to be built into a fire-proof building. A sectional

elevation is shown in (*a*) and a plan of the stairs is shown in (*b*). The stairs extend from the basement floor *a* in (*a*), to

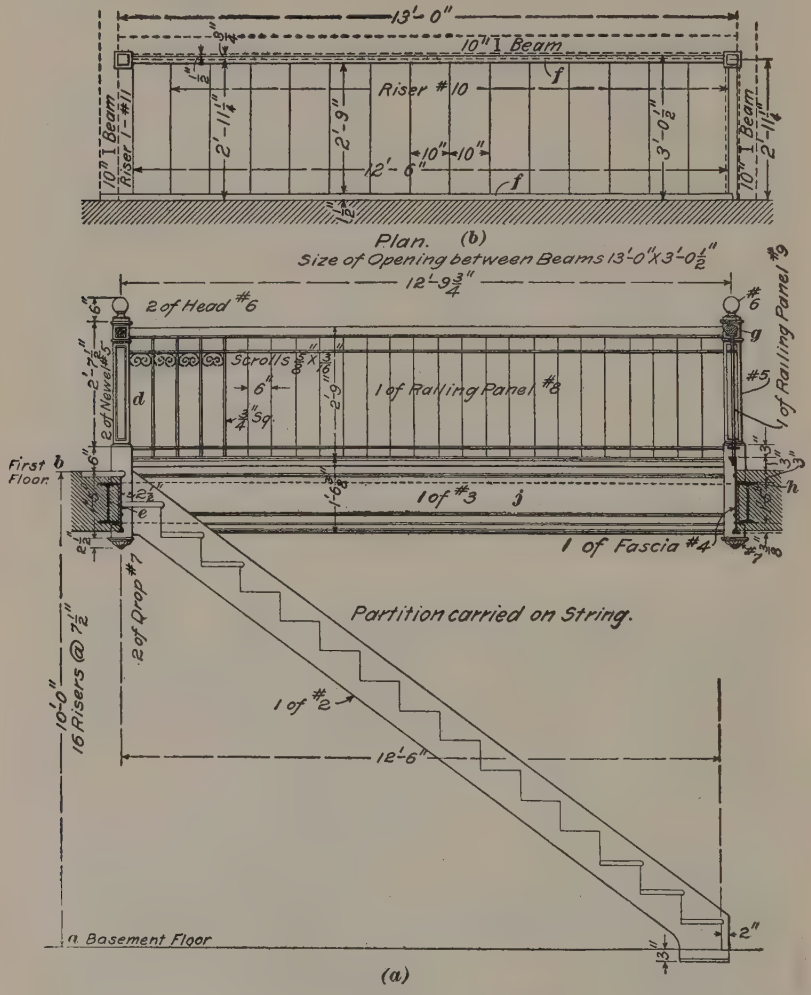


Fig. 6

the first floor *b*, the outline of the steps being plainly shown. The flight of stairs is contained between the two 10-inch **I** beams 13 feet apart, with a brick wall on one side of the stairs,

and a 10-inch I beam on the other, leaving a clear space of 3′ 0½″ for the stairs, the stairs having a rise of 10′ 0″ from floor to floor. The architect's drawing need not be as complete as shown in this illustration, but the architect must check the dimensions to see that they conform to his drawings, and he must examine the drawings carefully to see that they meet his approval as to style and detail. An example of a shop drawing for terra-cotta work is given later on.

28. Surveys.—In architectural work, the term *survey* means a drawing, made by a surveyor or an engineer, of a lot or piece of property, and sometimes of buildings existing on the property. This survey is useful to the architect in locating the buildings on the ground. It is drawn to scale and shows measurements in feet and decimals of a foot, whereas the measurements on architect's drawings are given in feet, inches, and fractional parts of an inch.

29. Accuracy of Drawings.—While the architect endeavors to have his drawings accurate, it often happens that errors and omissions are made in indicating parts of plans, as well as in dimensions or locations. There is an implied obligation on the part of the contractor finding such errors and omissions to report the discovery to the architect without delay, so that corrections can be made.

When work is to be fitted into a given place in a building, the contractor should obtain the measurement of this place at the building and should work to the dimensions there found, for the actual construction may vary somewhat from the dimensions shown on the plans. To insure against errors due to differences between the dimensions given on the drawings and the actual sizes at the building, an architect frequently places a notation on the plans, and especially on the scale details, to the effect that all dimensions must be verified at the building. Such a notation places the responsibility for the accuracy of the finished work on the contractor. Fig. 3 illustrates the use of this notation.

30. Precedence of Drawings.—The actual size of parts of the building shown on the full-size details are to be used in

preference to the sizes indicated on the scale details. In like manner, the scale details take precedence, in the matter of accuracy, over the working drawings or general plans.

Whenever a dimension is given on drawings, it should be followed in preference to a scaled measurement, as the drawing may have been made out of proportion, or the paper may have either stretched or shrunk. In case of serious discrepancies between the dimensions and the scaled measurements, the matter should be brought to the attention of the architect for a decision as to the correct dimension.

USE OF THE SCALE AND THE RULE

USE OF THE SCALE

31. Drawings Made to Scale.—Elevations, plans, and sections are made at a fraction of the actual size of the building, for the obvious reason that the building is too large to be drawn at its actual size on ordinary sheets of paper. The sheets could not be easily handled if they were so drawn, and the drawings need not be full-size in order to make the construction clear. When made at a fraction of the actual size, they can be drawn on a moderate-sized board and the drawings or blueprints can be handled conveniently at the building.

32. In order to show the plans at the reduced size, they are drawn *to scale*. Most elevations, plans, and sections are drawn to the scale of $\frac{1}{4}$ inch to the foot. When so drawn, each $\frac{1}{4}$ inch on the drawing represents 12 inches, or 1 foot, of the actual building. Such a drawing shows the building at one forty-eighth of its actual size.

The scale of $\frac{1}{4}$ inch to the foot is found by experience to be a very convenient scale to use in laying out buildings of ordinary size. For very large buildings a smaller scale is used, such as $\frac{1}{8}$ inch to the foot, in which case the drawing will be one ninety-sixth of the actual size of the building.

FIG. 7

33. Scale details are made from 1/24 to 1/4 of the actual size of the parts detailed. In such cases the following scales are used:

$\frac{1}{2}'' = 1'\,0''$, or $\frac{1}{24}$ actual size
$\frac{3}{4}'' = 1'\,0''$, or $\frac{1}{16}$ actual size
$1'' = 1'\,0''$, or $\frac{1}{12}$ actual size
$1\frac{1}{2}'' = 1'\,0''$, or $\frac{1}{8}$ actual size
$3'' = 1'\,0''$, or $\frac{1}{4}$ actual size

In full-size details, each inch represents an inch of actual size. The scale at which a drawing is made should always be marked on the drawing. When drawings at different scales appear on one sheet each drawing should be marked so as to avoid confusion.

34. The Architect's Scale.—The architect or designer in laying out drawings to any scale, uses an instrument called a *scale*. Whether the word scale refers to this instrument or to the scale of the drawing can easily be determined by the connection in which the word is used.

An illustration of a convenient type of an architect's scale is given in Fig. 7, the two sides (*a*) and (*b*) of the scale showing all the scales that have already been mentioned. The scale shown in the illustration is only 6 inches in length, which is a very convenient size for carrying in the pocket, and is also handy in making drawings. The standard length for a scale used in the drafting room is, however, 12 inches.

35. On the upper edge of the scale in Fig. 7 (*a*) are the $\frac{1}{8}$-inch and the $\frac{1}{4}$-inch scales. At the left end of the scale, the beginning of the $\frac{1}{8}$-inch scale is indicated by the fraction $\frac{1}{8}$, above which is $\frac{1}{8}$ inch divided into 12 parts, each of which represents an inch at the $\frac{1}{8}$-inch scale. To the right of this divided eighth are divisions of $\frac{1}{8}$ inch clear across the top edge of the scale, each eighth representing 1 foot and every fourth eighth being numbered.

Beginning at the right-hand end of the same edge of the scale, the edge is divided into $\frac{1}{4}$-inch divisions by the longer lines. The first $\frac{1}{4}$ inch is divided into 12 parts which rep-

resent inches at the $\frac{1}{4}$-inch scale. Every $\frac{1}{4}$ is just twice $\frac{1}{8}$, and the divisions are arranged so that the $\frac{1}{2}$-foot divisions of the $\frac{1}{4}$-inch scale are the same as the 1-foot divisions of the $\frac{1}{8}$-inch scale. Every alternate fourth division is numbered, and the user must be careful to avoid using the wrong set of numbers.

36. On the lower edge of the side of the scale shown in (*a*) are found the $\frac{1}{2}$-inch and 1-inch scales, while in (*b*) are shown the $\frac{3}{8}$-inch, $\frac{3}{4}$-inch, $1\frac{1}{2}$-inch, and 3-inch scales. These scales are arranged in pairs and are numbered in a manner similar to the scales already described. With each of these scales, one unit is shown subdivided into at least 12 parts, representing inches, and on the larger scales there may be finer divisions to represent parts of inches. Thus, on the 1-inch scale, at the right-hand lower edge in (*a*), it will be observed that fractions as small as $\frac{1}{4}$ inch may be read direct and the fourths may be divided by the eye so as to read eighths of an inch. On the 3-inch scale, shown in (*b*), the inch divisions are divided so that eighths may be read.

37. Using the Scale.—There are two methods of using the scale in connection with drawings: a given distance may be laid off from a fixed point, or a given space on the drawing may be measured.

In laying off a distance, such as 8 feet 6 inches, from a fixed point, and using the $\frac{1}{8}$-inch scale, place the 6-inch mark of the divided eighth at the point and make a point opposite the 8-foot mark on the edge of the scale, which will give the desired distance. The distance may also be laid off by placing the 8-foot mark at the point and making a point at the 6-inch mark of the divided eighth.

38. To measure a given space between two points on a drawing, the scale is placed so that one of the points is between the limits of the unit which is divided into inches, and the other point is at one of the unit marks on the edge of the scale. By reading the number of feet and inches between the two marks on the scale, the desired dimension is found.

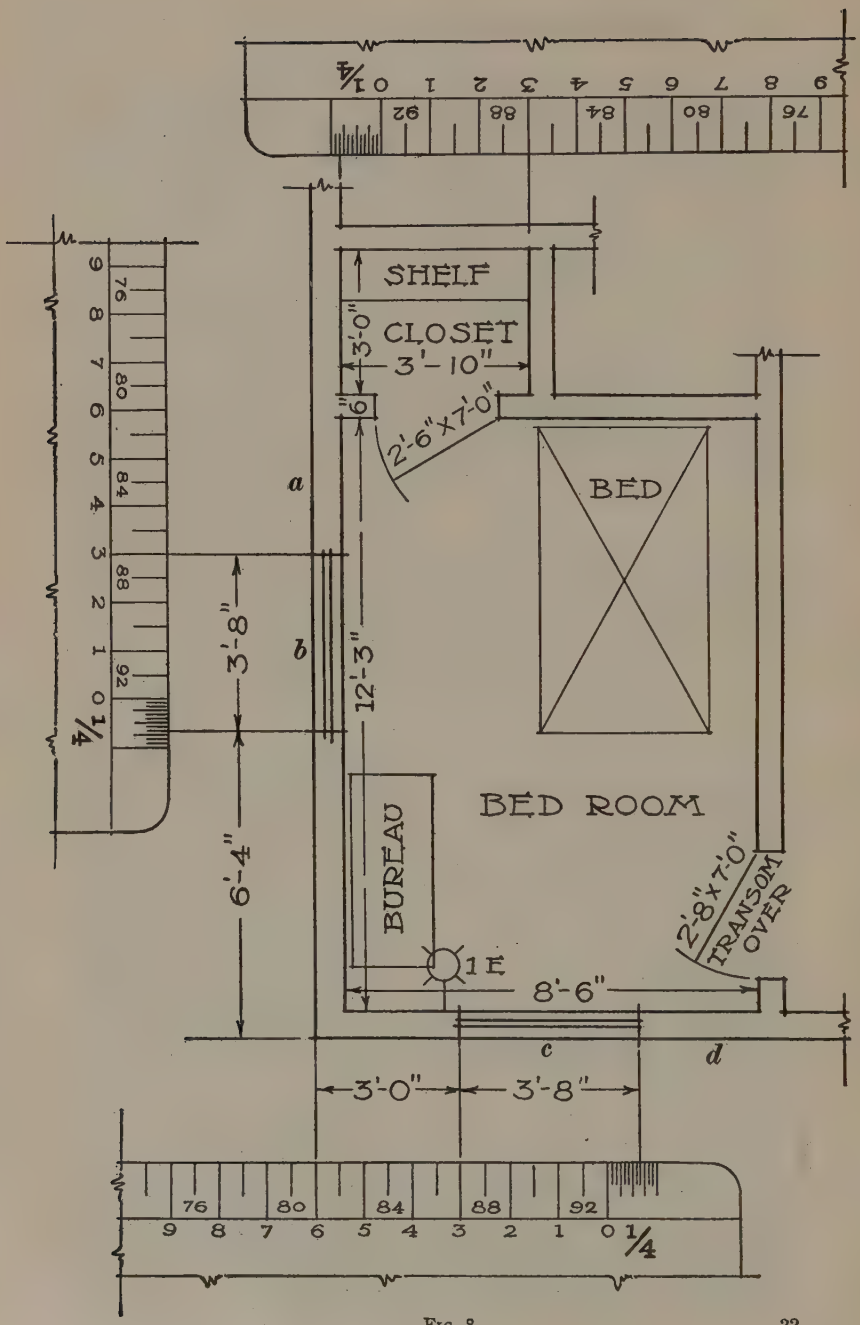

SHELF
CLOSET
3'-0"
3'-10"
6"
2'-6"X7'-0"
BED
a
b
3'-8"
12'-3"
6'-4"
BUREAU
BED ROOM
2'-8"x7'-0"
TRANSOM OVER
1E
8'-6"
c
d
3'-0"
3'-8"

FIG. 8

39. Reading Dimensions With the Scale.—In Fig. 8 is shown a portion of a plan of a dwelling. A bedroom and a closet are represented at the scale of $\frac{1}{4}$-inch to the foot, or $\frac{1}{48}$ of its actual size. The $\frac{1}{4}$-inch scale on the measuring scale will, therefore, be used in determining the measurements. The scale shown in the illustration is numbered at every foot for convenience in reading. In the wall *a* is shown the window *b*. This window is marked on the drawing as being 3′8″ in width. When the scale is applied to the width of the opening on the drawing, it will be seen that the width is three of the $\frac{1}{4}$-inch divisions on one side of the O mark, and eight of the $\frac{1}{12}$ divisions on the other side of the O mark, thus giving the dimension 3′8″. By applying the scale in a similar manner to the window *c* in the wall *d*, the same result will be found. The distance between the side of the window and the corner of the wall will be found to be 3′0″, as the distance is three of the $\frac{1}{4}$-inch spaces.

The width of the closet will be found by applying the scale as shown at the upper part of the drawing, and is 3′10″. The scale must always be applied parallel to the distance to be measured.

USE OF THE RULE

40. The architect and his draftsmen use the scale in laying out and in reading the dimensions of the drawings that they make for buildings. The contractor and foremen generally use the *rule* sometimes called the *carpenter's rule*. Either the 2-foot rule or the zigzag folding rule may be used. These rules are divided into inches and fractions of an inch, such as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$. Dimensions such as are marked on the drawing shown in Fig. 8 are usually given, but in Fig. 9 is given an illustration of the methods used in taking off dimensions or measurements from a drawing by means of a rule.

41. Example of the Use of a Rule.—In Fig. 9, on the right-hand side, a rule is shown applied to a drawing to obtain the length of the room, and the measurement shown is $3\frac{1}{16}$ inches. The drawing is at the scale of $\frac{1}{4}$-inch to the foot. The

3 inches, therefore, represent $3 \times 4 = 12$ feet, and the $\frac{1}{16}$ inch represents $\frac{1}{4}$ of 1 foot, or 3 inches. This dimension will, there-

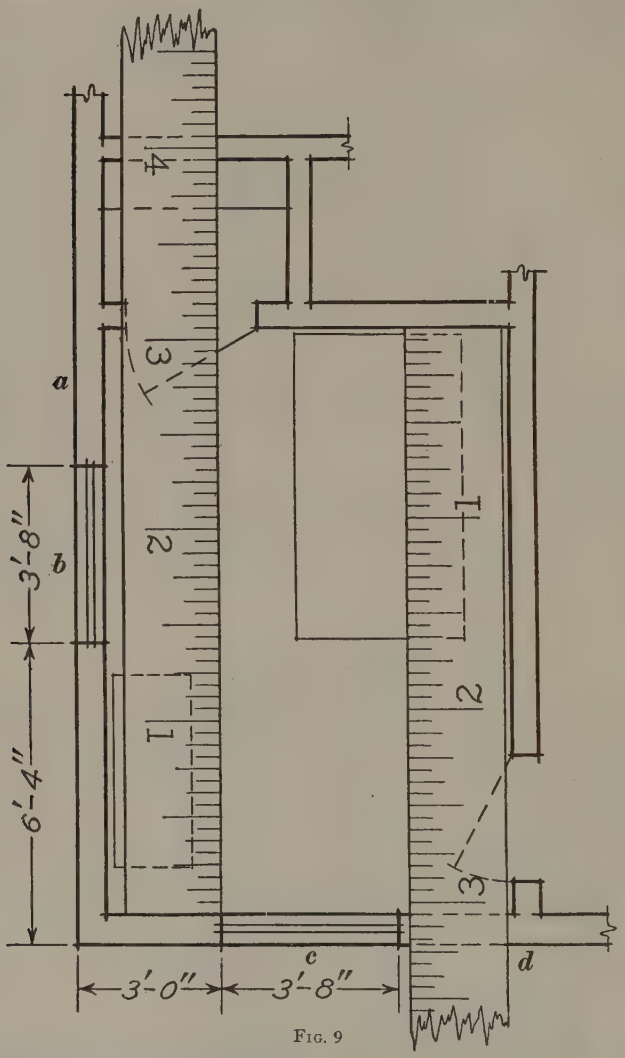


Fig. 9

fore, be read as 12 feet 3 inches. The length of the room including the closet is $3\frac{15}{16}$ inches by the rule. The 3 inches represent 12 feet and the $\frac{15}{16}$ represents $3\frac{3}{4}$ feet or 3 feet 9 inches.

The total length of the line is, therefore, 15 feet 9 inches. It should be remembered that each inch on the rule equals 4 feet, each $\frac{1}{4}$ inch represents 1 foot, and each $\frac{1}{16}$ inch represents 3 inches at the scale of $\frac{1}{4}$ inch = 1 foot.

42. Measuring Scale Details.—Scale details are made at scales such as $\frac{1}{2}$ inch to the foot, $\frac{3}{4}$ inch to the foot, etc. In measuring details drawn at $\frac{1}{2}$ inch scale, each inch on the rule represents 2 feet on the drawing, and each $\frac{1}{16}$ inch on the rule represents $\frac{1}{8}$ of a foot, or $1\frac{1}{2}$ inches on the drawing.

In measuring details drawn at the scale of $\frac{3}{4}$ inch to the foot, each $\frac{3}{4}$ inch on the rule measures 1 foot on the drawing, each $\frac{1}{4}$ inch measures 4 inches on the drawing, and each $\frac{1}{16}$ inch

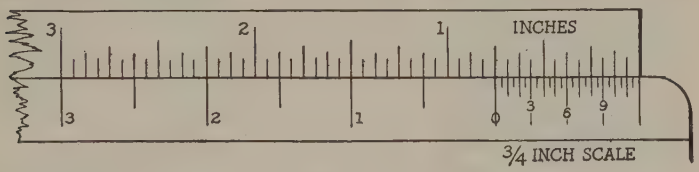


Fig. 10

on the rule represents 1 inch on the drawing. A comparison of a portion of a 2-foot rule with a portion of the $\frac{3}{4}$-inch scale is shown in Fig. 10, and shows this relation clearly.

Drawings made full-size can be measured directly with the rule, as the represented objects or parts of the building are at their actual size.

43. Practice in the Use of the Scale and Rule. Those wishing to obtain a clear understanding of what drawings represent, should purchase a scale and measure the various parts of the accompanying blueprints, checking the dimensions, etc., and thus become familiar with the use of the scale. It will also be well to purchase a 2-foot rule, and to become familiar with its use in measuring plans.

SYMBOLS FOR MATERIALS

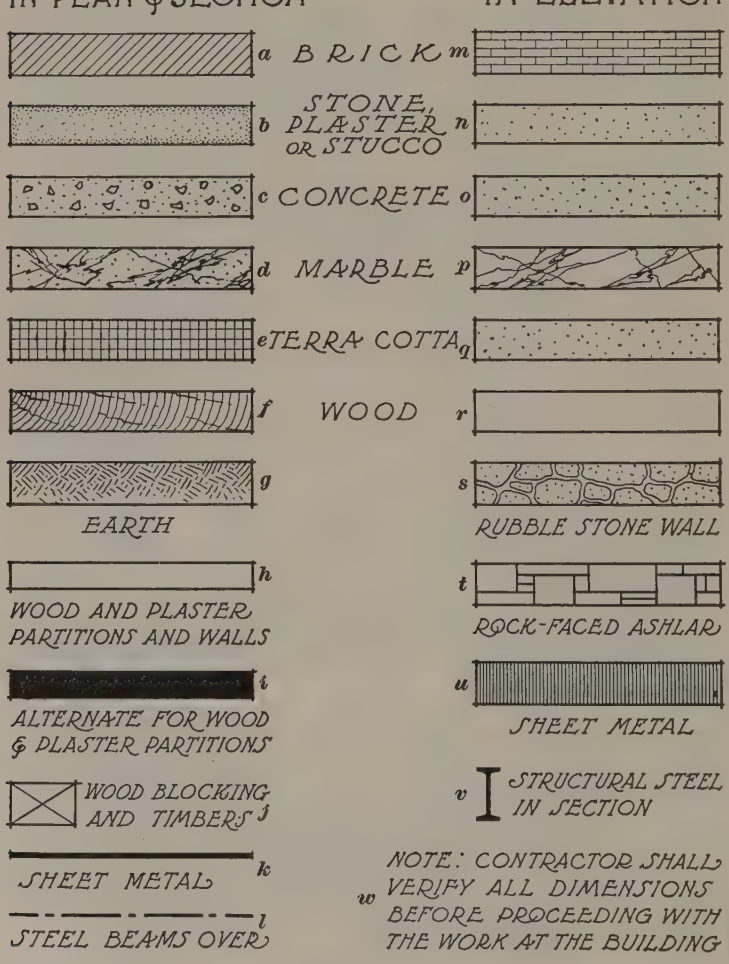


FIG. 11

INDICATIONS USED IN DRAWINGS

INDICATIONS OF MATERIALS

44. Methods of and Reasons for Indicating Materials.—As has been stated, various indications are used to represent the materials employed in the construction of buildings. These indications consist of lines, dots, and other marks, forming a different indication for each material, so that just what material is used in the construction of a given part may be determined at a glance. The reason for indicating the materials in this way is that these indications may readily be made on the tracings, and any number of blueprints may be made from the tracings. In the past, colors were used to indicate these various materials. As colors could not be readily printed, it was necessary to make several drawings or prints and to color every one separately by hand. This was very expensive, and the present method of indicating by various markings and lines has been adopted. Examples of these indications are given in Fig. 11. All these indications are more or less arbitrary, and there is no uniform practice in using them, but they represent the practice of a great many of the leading architects of the United States.

45. Materials Seen in Section.—Plans and sections usually show cuts made through various materials, and the indications of some of the principal materials so cut are shown in Fig. 11 at *a* to *l*, inclusive. At *a* is shown the indication for brick; at *b* stone, plaster, or stucco; at *c*, concrete; at *d*, marble; at *e*, terra cotta; at *f*, wood; at *g*, earth; at *h*, wood and plaster partitions and walls; at *i*, alternate for wood and plaster partitions; at *j*, wood blocking and timbers; at *k*, sheet metals; and at *l*, steel beams over an opening in the plan.

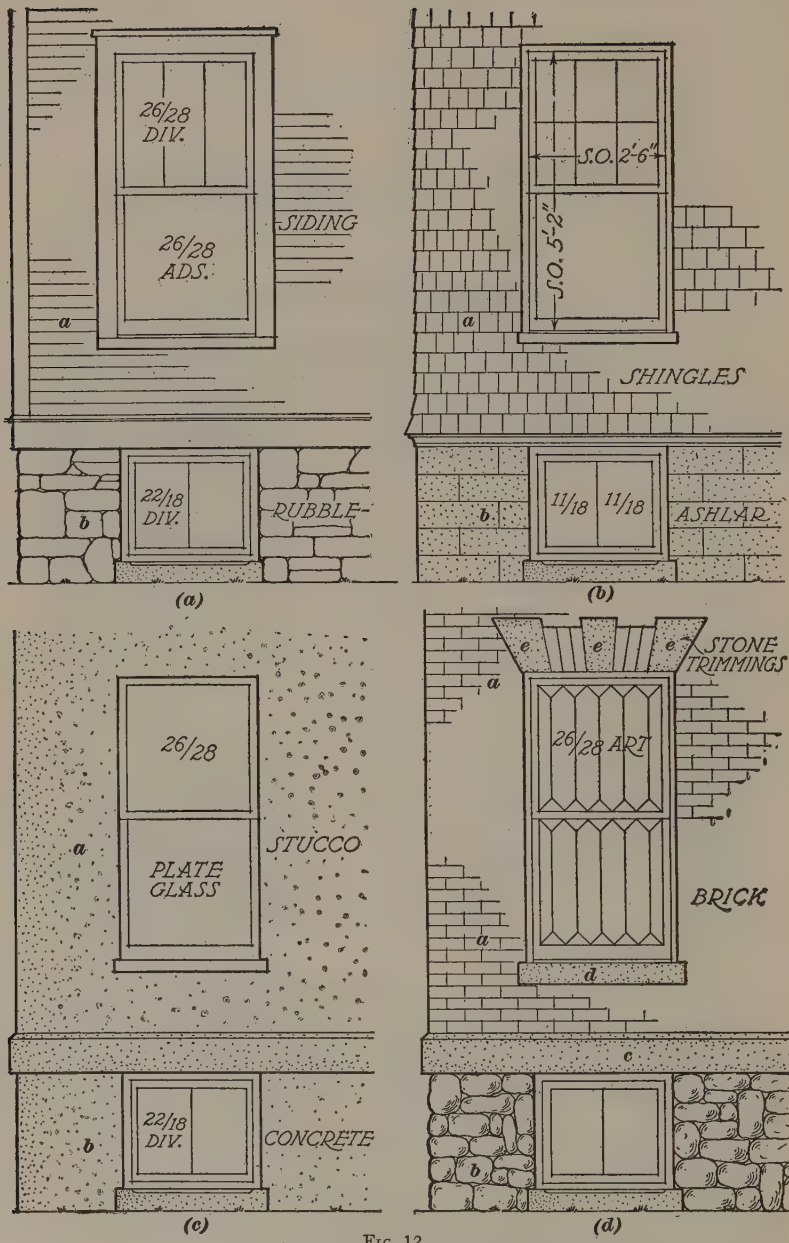

26/28
DIV.
26/28
ADS.
SIDING
a
22/18
DIV.
b
RUBBLE
(a)
S.O. 2'-6"
S.O. 5'-2"
a
SHINGLES
11/18
11/18
b
ASHLAR
(b)
26/28
a
PLATE
GLASS
STUCCO
22/18
DIV.
b
CONCRETE
(c)
e
e
e
STONE
TRIMMINGS
a
26/28 ART
BRICK
a
d
c
b
(d)

FIG. 12

46. Materials Seen in Elevation.—In Fig. 11 from *m* to *u*, inclusive, indications are shown which represent materials as indicated in elevation. Thus, at *m* is an indication of brick in elevation; at *n*, stone; at *o*, concrete, etc. It will be noted that the indications at *n*, *o*, and *q* are somewhat similar, but reference to the corresponding parts in the plans will assist in distinguishing between these indications. In some cases, materials, such as stone, are shown in such a manner as to indicate the sizes or shapes of the pieces of material used, or the method of placing them in the building, as in *s* and *t*. These indications are generally carried over only a small portion of the total surface shown on the drawing.

47. Application of Indications.—In Fig. 12 are shown examples of the use of the indications previously mentioned, together with additional indications that are often shown on drawings. In Fig. 12 (*a*) at *a*, where beveled siding is indicated, the horizontal lines are spaced to show the actual width of the boards. At *b* rubble is indicated. In (*b*) wood shingles of random width are indicated at *a*, and ashlar at *b*. In (*c*) at *a* a stucco surface is indicated, the same indication being used whether the stucco is applied to metal lath, hollow tile, or other material. At *b* a concrete surface is indicated, the indication being very similar to that for stucco. In (*d*) at *a* a brick surface is shown, the indication being the same regardless of whether the brick is a part of a solid wall, or a brick veneer supported by a wooden frame. At *b* is an indication of a field-stone wall, at *c* a stone water-table, at *d* a stone sill, and at *e* stone trimmings in the arch over the window.

48. To show the application of this system of indicating materials in working drawings, reference may be made to the blueprints of the South Elevation, Basement Plan, and First Floor Plan, and to the Transverse and Longitudinal Sections. In the South Elevation, stucco surfaces are indicated at *e*, a brick surface at *f*, a shingled surface at *g*, and metal surfaces at *h*. The indications of the material on a small portion of the surface are obviously sufficient to identify the entire surface. In the Basement Plan at *c* is shown a concrete wall, and at *d*

is shown a brick wall, at the end of which is a brick chimney *e*. In the First Floor Plan at *c* is shown a brick fireplace. Two kinds of brick are indicated by the different directions of the lines, one indicating the brick used in facing the mantel, the other showing the common brickwork used for the body of the chimney. In the Transverse Section at *a* is a section through a concrete wall, surrounding which are indications of earth. At *b* is a section through a concrete wall, at *c* is a section through the concrete floor, and at *d* is a section through a brick wall which supports a brick trimmer arch *e* under a concrete hearth.

49. It is advisable to place a list, or key, of the indications on the drawings, as is done in the Basement and First Floor Plans, and in the Transverse and Longitudinal Sections.

50. Descriptions and Abbreviations.—There are numerous things that cannot be shown completely by the use of indications. These are usually indicated by brief descriptions and abbreviations which are put on the drawings by the draftsman. In some cases the entire description must be printed on the drawing. An example of a sentence which is sometimes placed on a drawing is given in Fig. 11 at *w*. Further examples of these descriptions or notes may be seen by inspecting the elevations, plans, and sections.

51. Words or abbreviations of words are also used as indications, and by usage have acquired definite meanings. Examples of these abbreviations are given in the accompanying list. Further examples of abbreviations will be found in the South Elevation, such as *S.O.*, which indicates sash opening, and *R.C.*, which indicates rain conductor. In the First Floor Plan are shown abbreviations such as *Rad.* for radiator, *Reg.* for register, and *Refrig.* for refrigerator, etc.

EXAMPLES OF ABBREVIATIONS USED ON DRAWINGS

Abbreviations	Explanations	Abbreviations	Explanations
C. I.	Cast-iron	Col.	Column
Gal. I.	Galvanized iron	Rad.	Radiator
W. I.	Wrought iron	Reg.	Register
T. C.	Terra cotta	D. H.	Double-hung sash
W. P.	White pine	No. or #	Number
Y. P.	Yellow pine	B. L.	Building line
D. S.	Double-strength glass	G. L.	Grade line
P. G.	Plate glass	C. L.	Center line
L. G.	Leaded glass	C. C.	Center-to-center

INDICATIONS OF PARTS, OR ELEMENTS, OF BUILDINGS

52. General.—On drawings, the indications of the various parts, or elements, of a building should show more than the mere materials of which the parts are constructed; the peculiarities of the construction of the various parts should be indicated. This construction depends on the nature of the materials used, and the character of the building in which the parts occur.

53. Building materials may be used in various combinations in the same building. Thus, a brick wall may have an exterior facing of face or special brick; a hollow-tile wall may support a facing of brick; a wooden frame may support an outer covering, or veneer, of brick or stucco; or a steel frame may be used to support walls of brick, terra cotta, or stone. A building may have exterior brick walls, with wooden, steel, or reinforced-concrete floor construction.

54. In general, buildings in which the foundations and exterior walls are constructed wholly or principally of brick, stone, hollow tile, or concrete, are known as *masonry buildings*.

When the walls or floors are supported principally on a framework of structural steel, the buildings are known as *steel-skeleton buildings*.

Buildings in which the principal parts, such as the foundations, walls, floors, and roofs, are built of concrete reinforced with metal rods or bars, are known as *reinforced-concrete buildings.*

Buildings in which the superstructure, or the portion of the building above the foundation wall, consists of a wooden framework which supports an outer covering of siding, shingles, stucco, or other material, are known as *wooden-frame buildings.* The superstructure is usually supported on a masonry foundation, which may be of brick, stone, hollow tile, or concrete.

55. Buildings are made up of many parts, among the more important being the footings, foundations, walls, piers, partitions, chimneys, floors, roofs, doors, and windows. Some of these parts are shown in the plans, others in the elevations, and still others are seen only in the sections. Thus, the footings and foundations are indicated usually in the basement plan, and are seen also in the sections, the construction of walls, piers, and partitions is seen in the plans, while the appearance of the outside walls and piers is seen in the elevations, and the appearance of the partitions and inside piers is seen in the sections. Chimneys are seen in the plans, and in the sections, while portions of them are seen in the elevations, as in the blueprint of the South Elevation. Floors and roofs are seen principally in the sections, although the roof construction appears partly in the plans, as in the Third Floor Plan; partly in the elevations, and in the sections.

Since the indication of the parts of the buildings depends so much on the nature of the materials used, these indications will be discussed in the following articles under the headings of the various materials.

STONE

56. Footings and Foundations.—Footings and foundations are generally built of some masonry material, such as stone, brick, concrete, or tile. Except for large and important buildings, footings are seldom shown on a separate plan. The customary method of indicating footings is by broken lines

on each side of the wall, as at *a* in the Basement Plan. The width of the footing is shown on the Basement Plan, as at *a*, and the vertical thickness or height of the footing is shown in the Sections. When the footing is shown in section, the space between the lines of the footing is filled with the indication of the material of which the footing is composed, as at *a* in the Longitudinal Section. When seen in elevation in the Section, the footing is shown only in outline, as at *b*.

57. The foundation walls, at least up to grade, are generally made of rough masonry or concrete. It is, therefore, important to show the grade line, or the finish line of the ground, on the elevations and sections of the building, in order to show where the rough masonry stops. The portions of the foundation wall projecting above the finished grade are usually built with more care and with better materials than those below. The foundation wall generally contains the windows which light the cellar or basement, and the plan of such cellar or basement is commonly taken so as to be a section through these windows. Consequently, the location of the windows can be marked on the cellar or basement plan.

58. The vertical sections through the foundation walls are usually taken through one of the wall openings, such as a window or door. This enables the architect to show the relation of the door or window sills and the construction over the tops of these features. The height of the window and door sills above the finished cellar floor can then be marked on the section for the instruction of the contractor. When the section does not pass through the basement windows or doors, the heights of the window sills are sometimes marked on the elevations, as at *i* in the South Elevation.

59. Stone Walls and Piers.—Stone walls and piers are shown in plans by lines bounding the masonry. These lines give the correct size of the construction according to the scale at which these parts are shown. Dimensions are given for the thickness of walls, and the sizes of piers. The space between the lines of the walls and inside of the bounding lines of the

piers is filled with the indication of the material of which the wall or pier is composed. Thus, in Fig. 13 (*a*), a stone wall is indicated; in (*b*) a brick wall faced with stone, and in (*c*) a stone pier. In masonry seen in plan or section, there is no attempt made to represent the individual stones, bricks, or pieces of material in the plan or sections, it being understood that the work will be done according to the specifications or the indications on the elevations.

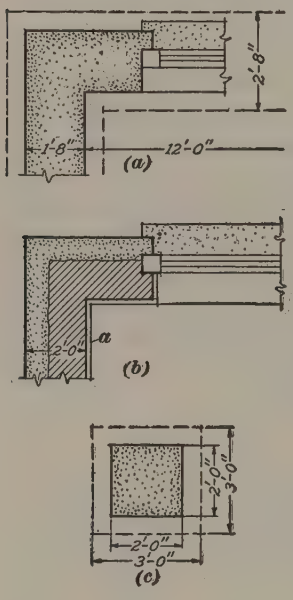


FIG. 13

60. When walls of different thicknesses occur in a building, each wall should be marked so that the workmen will know where the different thicknesses occur. The thickness indicated on the plans usually refers to the actual thickness of masonry rather than to the total thickness of the masonry and any plastering which may be applied to it. An additional line close to the inner surface of the wall as at *a* in Fig. 13 (*b*), indicates that the wall is furred and plastered. When plastering is applied directly to the wall, the additional line is omitted, the wall being shown as in (*a*). In the latter case the plastering would be called for in the specifications. Piers are rarely furred, the plastering, when required, being applied directly to the surfaces.

61. The practice is divided between indicating the thickness of masonry in inches, as 18″, 20″, 24″, etc., and by feet and inches, as 1′6″, 1′8″, 2′0″, etc. The figures giving the thickness of walls should be read carefully so that 18″ will not be mistaken for 1′8″, or 20″ for 2′0″, etc. In general, the dimension is given in inches when it refers to the thickness of the wall, and in feet and inches when it is a dimension from one face of the wall to the other, in connection with a line of dimensions across the building.

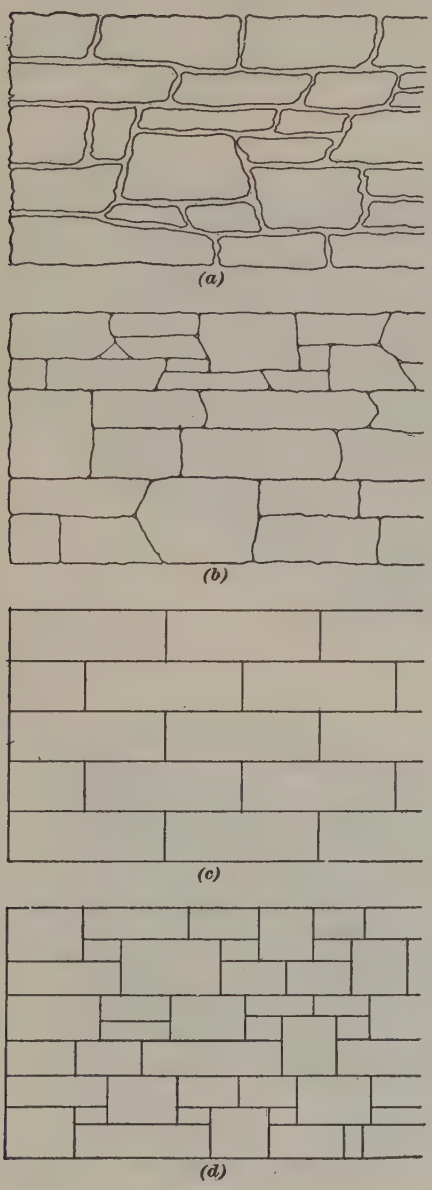


FIG. 14

62. Stone walls seen in elevation are indicated according to the manner in which they are constructed. Stone may be used to make a given length of wall without regard to the size, shape, or arrangement of the separate stones, or it may be laid to a prearranged plan. In the first case the work is known as *rubble,* and in the second case it is known as *ashlar.*

63. A typical method of showing rubble work on the elevations is given in Fig. 14 (*a*), a greater or less portion of the wall being thus indicated. The finished wall of this construction is shown in Fig. 15. This work is known as *random rubble,* and the character of the work will vary with the nature of the stone. Where thin flat stones are used, the drawing will naturally represent such stones. Where rounded boulders are used, a different appearance will result, resem-

bling that shown at *b* in Fig. 12 (*d*). When the rubble is to be roughly coursed, it is indicated as in Fig. 14 (*b*), and the finished appearance of the wall will be shown in Fig. 16. This work is known as *coursed rubble*.

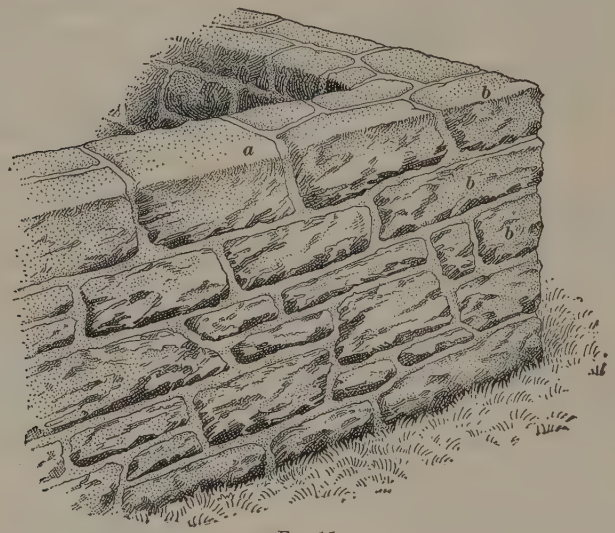


Fig. 15

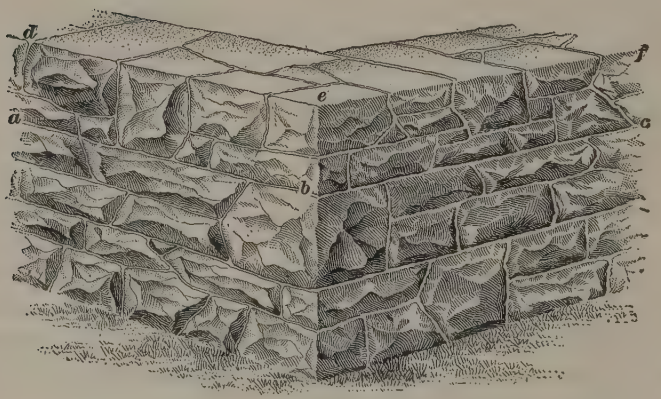


Fig. 16

64. Ashlar consisting of stones cut to certain dimensions is indicated as in Fig. 14 (*c*). This is known as *coursed ashlar*.

A finished wall of this construction is shown in Fig. 17. Ashlar is frequently used as *random-coursed ashlar,* as indicated in Fig. 14 (*d*). A finished piece of random-coursed ashlar is shown in Fig. 18.

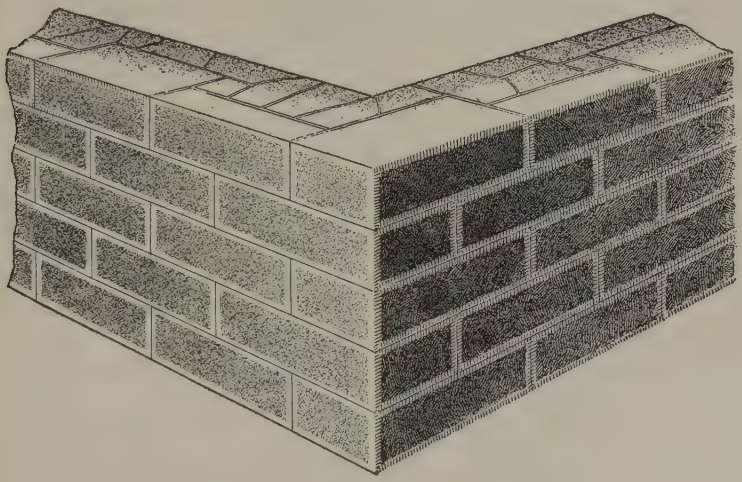


Fig. 17

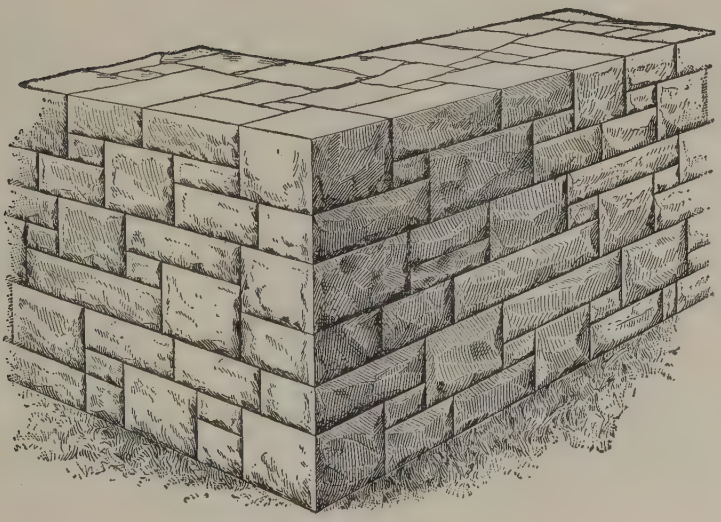
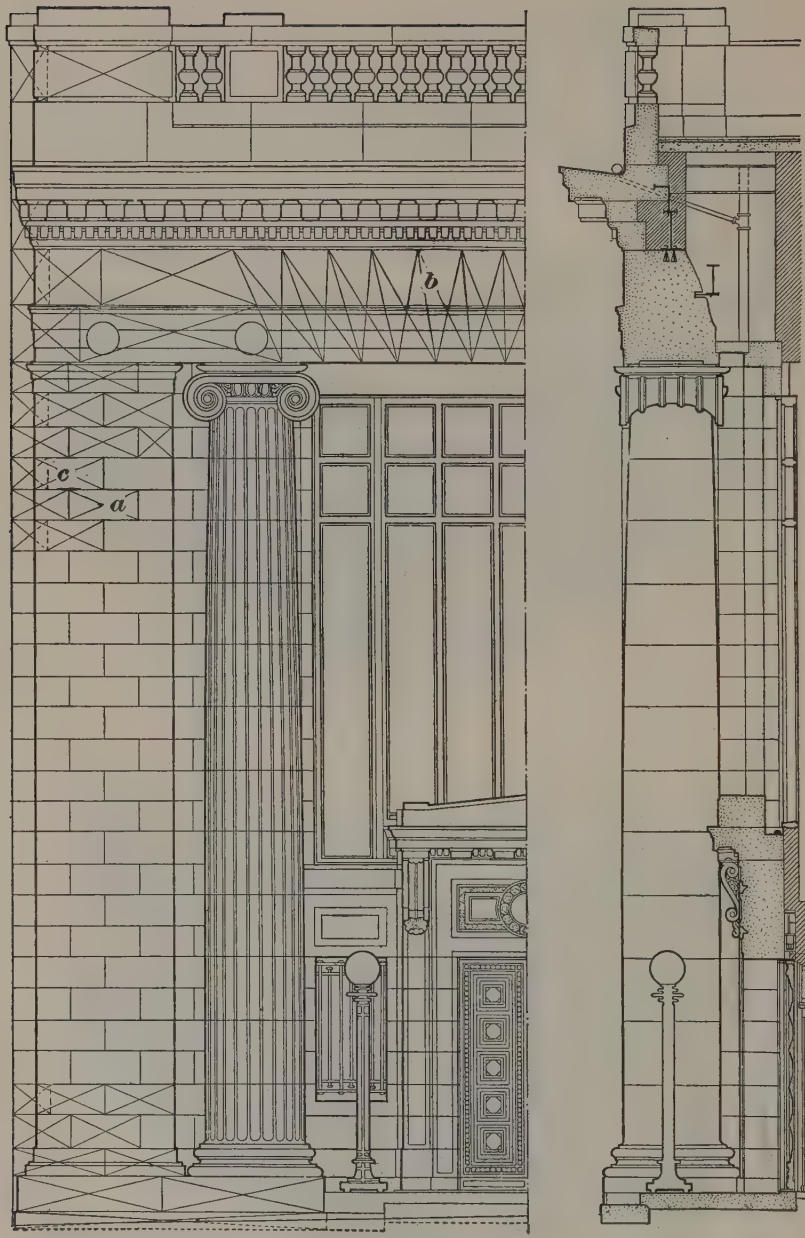


Fig. 18



(a) FIG. 19 (b)

65. Stone walls of the kinds shown in Figs. 14 to 18 are sometimes solid, as shown in Figs. 15 to 18, but generally the stone is only a facing, or veneer, as shown in Fig. 13 (*b*), backed up with brick, a cheaper stone, or tile. Stone walls are seldom less than 20 inches thick, although in some localities where the stone occurs in thin layers with parallel beds, they may be built as thin as 16 inches.

66. When stone is cheaper than brick, stone piers are sometimes used, but generally in the basement only. These piers are indicated in the same manner as outside walls. The dimensions which appear on stone piers, as in Fig. 13 (*c*), are for the masonry only, as any plaster that might be applied to the masonry is not indicated on the plans. Stone piers are seldom furred.

67. Cut-Stone Fronts.—Elaborate cut-stone fronts have each stone shown on the elevations, as in Fig. 19 (*a*). Individual stones *a* are shown by drawing lines from the diagonally opposite corners. The stones of the arch *b* are also shown by diagonal lines to indicate that they are single stones extending from the top of the columns to the bottom of the cornice. The parts of stones which extend behind pilasters and other stones are shown by dotted lines, as at *c*. A further indication of the jointing is seen in the section (*b*), which shows the arch stones and cornice supported by steel beams and backed up with brickwork.

68. When the fronts of the building are of cut stone, as shown in Fig. 19, they are usually backed up with a cheaper material, such as rubble stonework, brick, or hollow tile. The kind of stone and the manner of constructing the wall are generally shown in the small-scale sections and on large-scale details, but must also be fully described in the specifications.

69. Before any of the stone can be cut for a front, such as in Fig. 19, working or shop drawings must be prepared showing the exact shape of every stone. These drawings are generally made by the stone contractor who cuts the stone, and his drawings are submitted to the architect for approval.

BRICK

70. Brick Walls.—The inside and outside faces of brickwork are shown on plans by lines, as in Fig. 20 (*a*) and (*b*), the space between the lines being filled with the brick indication. A brick wall is sometimes backed with tile and is indicated as shown in Fig. 20 (*c*), and sometimes faced with the stone and indicated as in Fig. 13 (*b*). When brick walls are furred, an additional line is shown, as at *a* in Fig. 20 (*d*), but plaster applied directly to the wall is not indicated, a plastered wall showing the same indication as one not plastered. The measurement of the wall in any case refers to the thickness of the actual brickwork. Furring and plastering will add about 2 inches to this thickness.

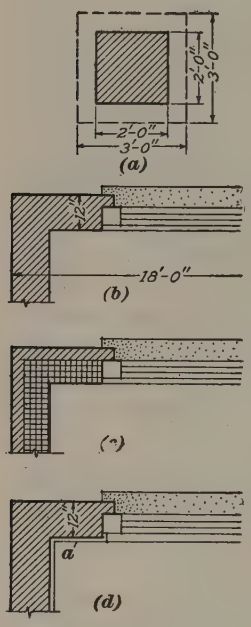


FIG. 20

The thickness of the brick wall is determined by the number of rows of bricks in the wall, each row being 4 inches to 4½ inches thick. A wall of two rows is between 8 inches and 9 inches thick; one of three rows is between 12 inches and 13 inches, and one of four rows is between 16 inches and 18 inches thick. Bricks vary somewhat in size and, therefore, cause a variation in the thickness of the wall. In localities where the smaller bricks are used, the walls will be about 8 inches, 12 inches, 16 inches, etc., thick, and may be so marked on the plans, while in places where larger bricks are used the walls will be 9 inches, 13½ inches, 18 inches, etc. The wall is laid to the outside lines of the building, any variation in thickness due to the size of the bricks or to the application of furring and plastering coming on the inside of the wall.

71. Face Bonds.—Brickwork is laid in a number of ways, the object being to secure a pleasing appearance by the arrange-

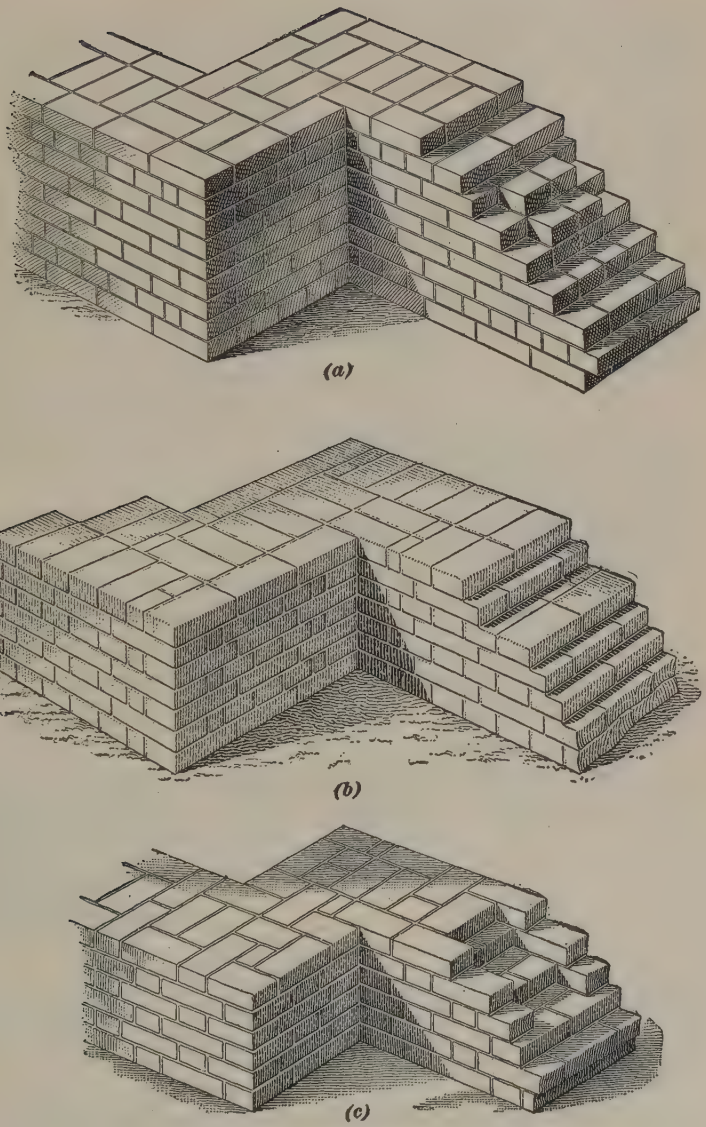


FIG. 21

ment of the bricks, and to bond the bricks together in the wall. Brickwork is indicated frequently on the quarter-scale elevations by lines showing the horizontal and vertical joints, as at *a* in Fig. 12 (*d*). In some cases, however, only the horizontal joints are shown. Scale details are prepared sometimes, especially when the more elaborate bonds are used, the drawing showing every brick in the face of the entire wall. *Common,* or *American, bond* is shown in Fig. 21 (*a*), *English bond* in (*b*), and *Flemish bond* in (*c*). When a special bond or pattern is used in the design, such bond or pattern, even when shown in scale details, usually is indicated in the quarter-scale elevations by suitable wording, and is described in the specifications.

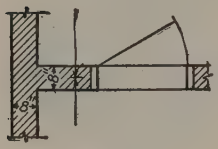


Fig. 22

72. Brick Partitions.—Interior brick walls, or brick partitions, are shown in plan with a line for each face of the wall, as in Fig. 22. If the partition is plastered, the finished wall will be $\frac{3}{4}$ inch to 1 inch thicker for each side on which plaster is applied, or $1\frac{1}{2}$ inches to 2 inches thicker for the entire wall when both sides are plastered. This extra thickness, however, is not shown on the plans, and no additional line is drawn to indicate the plaster when it is applied directly to the brick surfaces. An 8-inch brick wall would be marked *8″*, whether plastered or not. The dimensions showing the location of brick partitions are usually given to the center of the partition, so as to divide whatever variation there may be between the adjacent rooms.

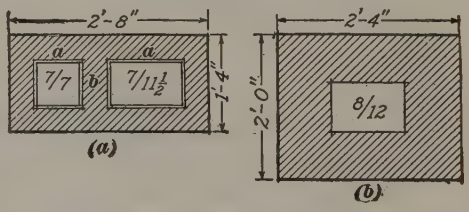


Fig. 23

73. Brick Piers.—Brick piers are shown in outline in plans, as in Fig. 20 (*a*), the space inside the outline being filled with the brick indication. The dimensions are given to the bounding lines of the brickwork, whether the pier is plastered

or not. Dimensions are sometimes given to the center lines of the piers, and this is particularly the custom with small piers, where the actual size may vary somewhat on account of the size of the bricks used.

74. Chimneys.—A chimney consists of one or more flues surrounded by a wall of sufficient strength. Chimneys are built usually of brick, although other materials such as stone, hollow tile, or concrete are sometimes used. In brick chimneys there must be at least 4 inches, or one thickness of brick, around the flue, as in Fig. 23 (*a*). When only 4 inches of brickwork is used around the flue, or when materials other than bricks are used, the chimney should be lined with terra-cotta flue lining *a* as a protection against fire, which might otherwise find its way through the joints. When the chimney is built with 8-inch brick walls, as in (*b*), the terra-cotta lining may be omitted.

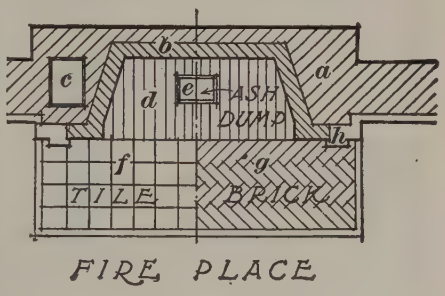


Fig. 24

Two or more flues combined in one chimney should have thin partitions of bricks between the flues, as at *b* in (*a*). These partitions, known as *withes,* separate the flues and bond the outside walls of the chimney together.

The sizes of the flues as indicated in Fig. 23 are 7″×7″, 7″×11½″ and 8″×12″.

75. Fireplaces.—In Fig. 24 is a plan of a fireplace. The fireplace is in a brick chimney *a,* as is indicated by the diagonal lines. The fireplace opening is lined with face brick *b,* as indicated by the diagonal lines in the thin space around the opening. At the left of the fireplace opening at *c* is a rectangular space surrounded by double lines. This space represents a flue coming up from below and passing the fireplace. The double line indicates a terra-cotta flue lining. The lines *d* in the hearth, or floor of the fireplace, represent the joints between the bricks

that are used to pave the fireplace. At *e* is an iron ash door with a cover supported on pivots, which opens into a flue through which the ashes drop into an ash-pit in the cellar. The portion of the hearth that extends in front of the fireplace is shown finished in tile on the left side *f*, and with bricks *g* on the right side. These sides are shown differently to show the different indications for these materials. The double lines around the outside of the tile and brick hearths indicate a wooden border that is fitted against the brick and tile, and is nailed to the floor. At *h* is indicated the section through the mantel or wooden finish of the fireplace that forms a framework enclosing the face brick of the fireplace opening. A study of the fireplaces shown in the living room and on the porch, in the First Floor Plan and in the Longitudinal Section, will show the use of these indications.

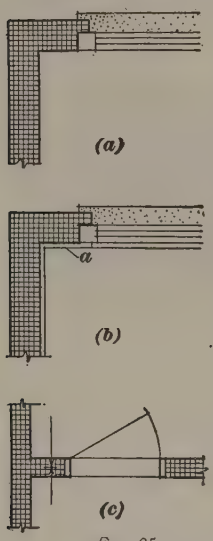


FIG. 25

HOLLOW TILE AND TERRA COTTA

76. Hollow-Tile Walls and Partitions.—Hollow tile is used for walls and partitions in practically the same manner as brick, the usual indication being given in Fig. 11 (*e*). The walls may be from 6 inches to 16 inches or more in thickness, and the inside surface of the tile may be furred out in the same manner as brick walls. As with stone and brick walls, the measurement of the hollow tile wall refers to the thickness of the tilework, and not to the combined thickness of the tile, furring, and plastering. In Fig. 25 (*a*), is shown a tile wall as it would appear in plans with or without plaster on the interior surface or stucco on the exterior surface. In (*b*) is shown a similar wall furred. The additional line *a* indicates the furring and plastering, in the same manner as described for stone and brick. In (*c*) are shown partitions of hollow tile. These indications will usually appear in the architect's plans when hollow tile is used.

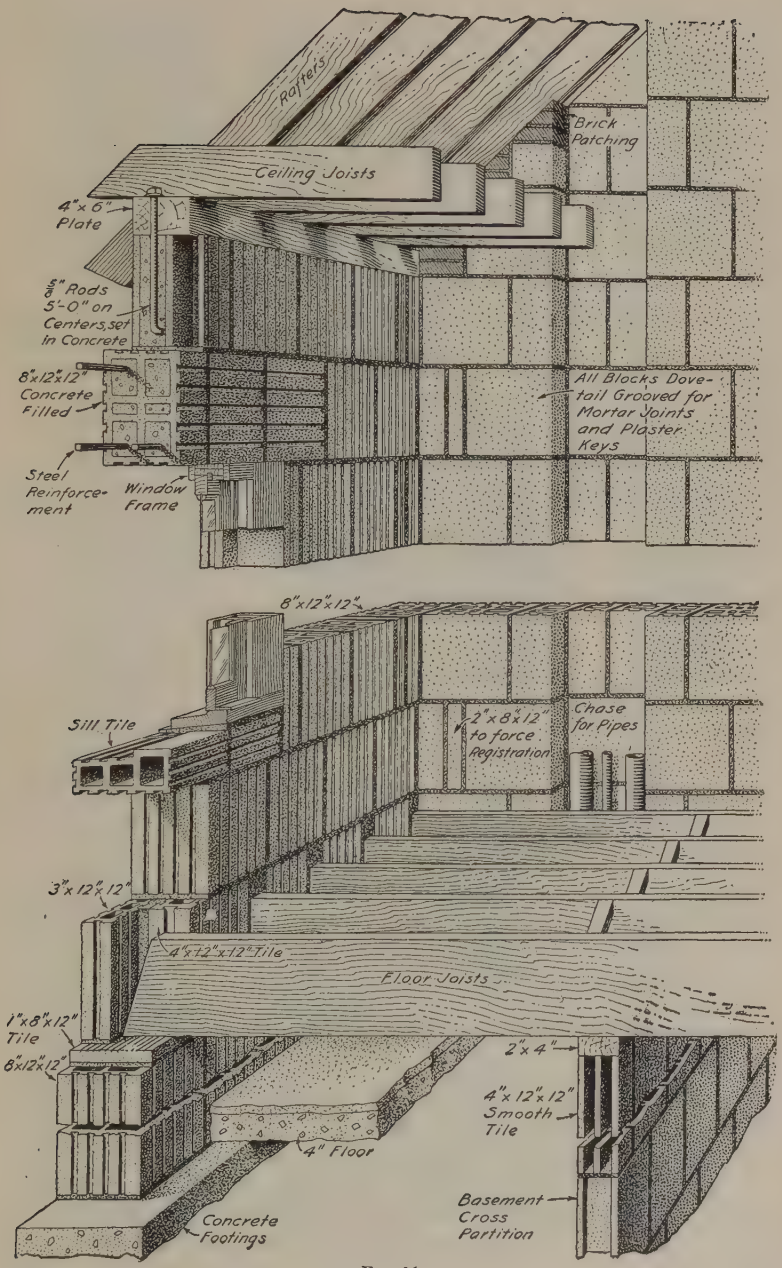

Rafters
Brick Patching
Ceiling Joists
4"x 6" Plate
5/8" Rods 5'-0" on Centers, set in Concrete
8"x12"x12" Concrete Filled
All Blocks Dove-tail Grooved for Mortar Joints and Plaster Keys
Steel Reinforce-ment
Window Frame
8"x12"x12"
Sill Tile
2"x8"x12" to force Registration
Chase for Pipes
3"x12"x12"
4"x12"x12" Tile
Floor Joists
1"x8"x12" Tile
8"x12"x12"
2"x4"
4"x12"x12" Smooth Tile
4" Floor
Basement Cross Partition
Concrete Footings

FIG. 26

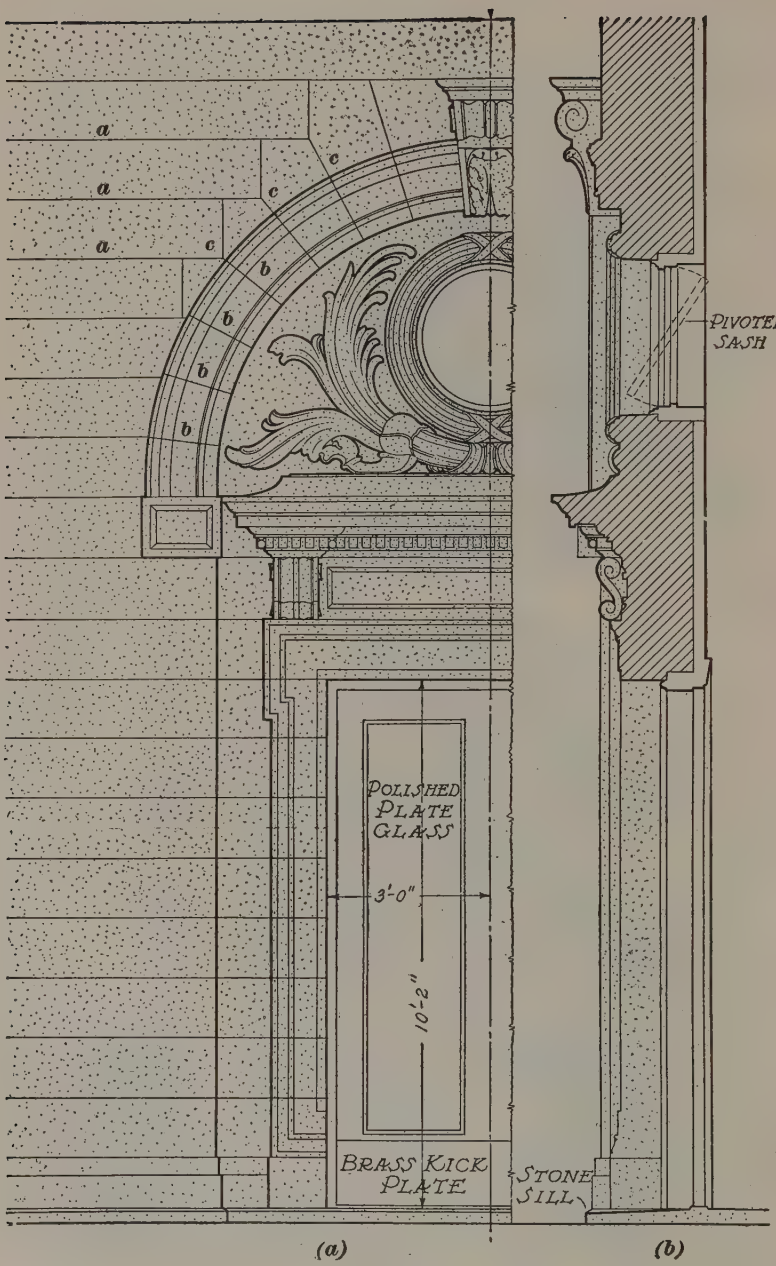

a
a
a
c
c
c
b
b
b
b
POLISHED PLATE GLASS
3'-0"
10'-2"
BRASS KICK PLATE
STONE SILL
PIVOTED SASH
(a)
(b)

FIG. 27

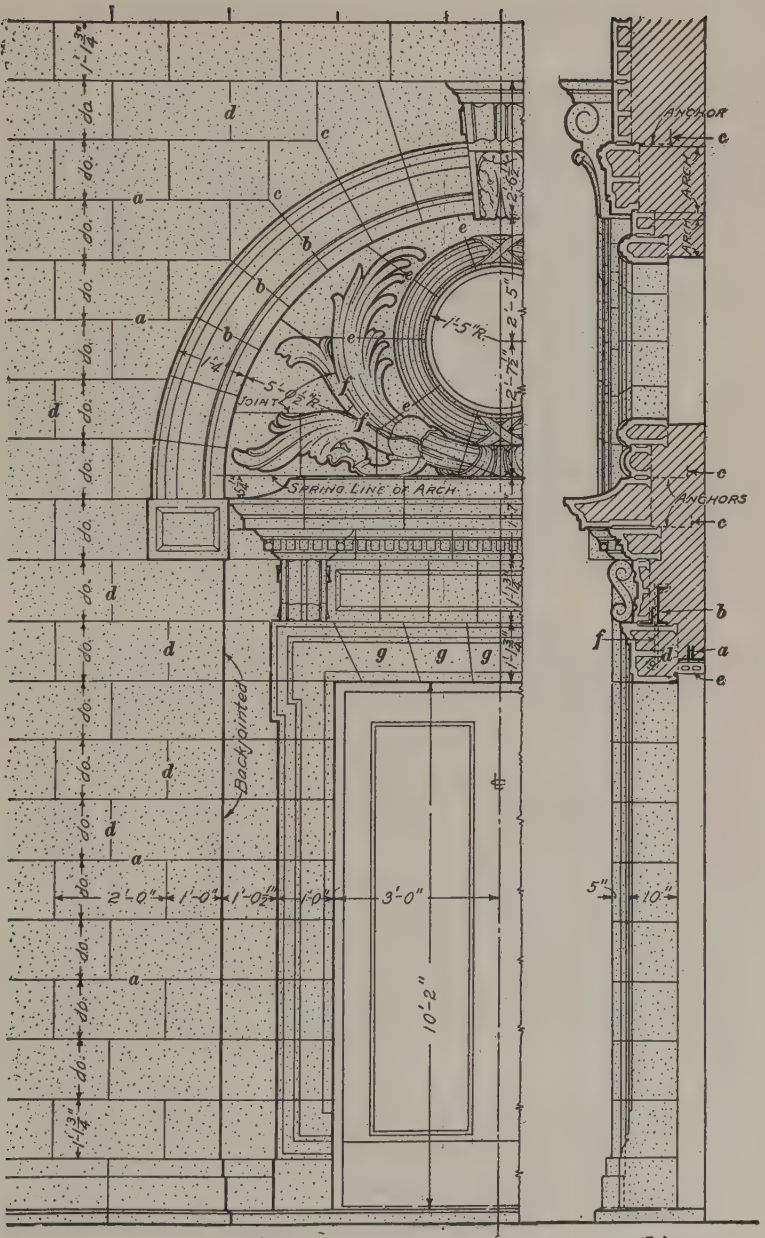

SPRING LINE OF ARCH
JOINT
Back pointed
2'-0"
1'-0"
1'-0½"
1'-0"
3'-0"
10'-2"
ANCHOR
ANCHORS
5"
10"
(a)
(b)

Fig. 28

77. Some types of hollow tile may be used with the surfaces exposed, in which case the elevation shows the general shape of the blocks, and suitable wording indicates the particular material used. Usually, however, the tile surface is coated with stucco, when a finish similar to *a* in Fig. 12 (*c*), is indicated. The floor plans, sections, and specifications are depended upon for further information regarding the construction or use of hollow tile.

In Fig. 26 are shown portions of a building with walls and partitions of hollow tile. This illustration shows the construction at various points as it would be found in first-class work. In this figure the outside walls are 8 inches thick, being built with 8″×12″×12″ blocks. The partitions are 4 inches thick, being built of 4″×12″×12″ blocks. The surfaces of the partition blocks are smooth, being intended for use without plaster. The outer faces of the walls are designed to receive a coating of stucco.

78. Architectural Terra Cotta.—A class of burned clay used for exterior decoration is known as *architectural terra cotta.* This material is used in a manner similar to fine cut-stone work.

79. Architect's Drawing for Terra-Cotta Construction.—The architect generally makes carefully detailed drawings for the doorways, cornices, or other parts of the building made of terra cotta, in a manner similar to that described for stone, in order that the design may be clearly understood and faithfully carried out. An example of such a drawing is given in Fig. 27, which is a detail of an ornamental doorway. In (*a*) is a half elevation, and in (*b*) is a section taken through the center line of the doorway. In this drawing there is no indication for the thickness or construction of the terra cotta. The work of indicating the terra-cotta construction is left to the draftsman in the office of the terra-cotta manufacturer, who makes a drawing like that shown in Fig. 28.

In small-scale drawings it is difficult to indicate terra cotta by the ordinary method, as this material is rarely over 1 inch thick, and, therefore, does not permit indications to be made

at small scales. In large-scale details, however, the material can be indicated as in Fig. 28 (*b*). The characteristic form of the blocks, as shown in this figure, is such as to identify clearly the parts that are formed of terra cotta. The hatching inside the blocks indicates brickwork with which the hollow spaces in the terra-cotta blocks are filled.

80. Example of a Manufacturer's Drawing.—In Fig. 28 is shown the manufacturer's shop drawing of the same entrance that was shown in Fig. 27. It will be noted in Fig. 28 (*a*), that the horizontal joints *a*, of the plain wall, the radiating joints *b*, of the arch, and the joints *c* between the wall and the arch, as shown in Fig. 27, have been retained. Vertical joints *d*, Fig. 28 (*a*), however, have been added to show the length of the wall blocks. The joints *e* and *f* are suggested for the ornament over the entrance. These joints are made to follow the form of the ornament as far as possible, so that they may be partly concealed.

In Fig. 28 (*b*) are shown the contours of the terra-cotta blocks that occur in this section, and also the depths that these blocks are set into the wall, and the manner in which they are secured or supported. All of the terra cotta over the doorway, and the masonry with which it is backed up, are supported by the steel members shown at *a* and *b*. Anchors *c* are used to tie the projecting blocks to the body of the wall. The blocks *d* in (*b*) are designed to form a self-supporting arch, as shown at *g* in (*a*). To prevent any settlement of these blocks or opening of the joints between them, they are usually anchored to the steel members by means of small suspension rods shown at *f* in (*b*). The blocks *e* in (*b*) are likewise suspended from the steel member *a*. The diagonal lines show the backing, which consists of brickwork.

81. In addition to the general dimensions, the manufacturer's drawings usually indicate the size of the blocks, as shown in Fig. 28 (*a*). When these scale drawings have been approved by the architect, the manufacturer proceeds to lay out the details of the various blocks. When the blocks are all made and fitted, a letter and a number are marked on the back of each for the

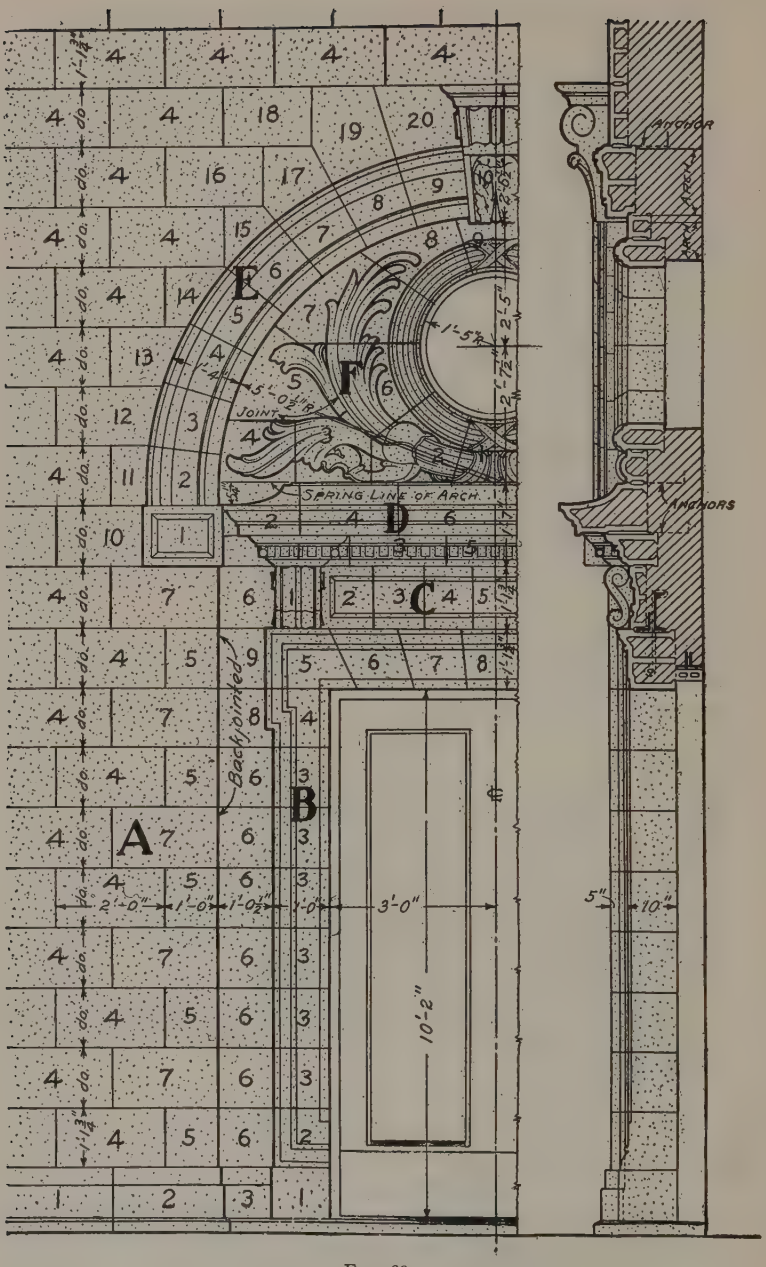

A
B
C
D
E
F
Backjointed
SPRING LINE OF ARCH.
JOINT
5'-0½" R.
1'-5½"
2'-7½"
2'-5"
3'-0"
10'-2"
2'-0"
1'-0"
1'-0½"
1'-0"
5"
10"
ANCHOR
ANCHORS

FIG. 29

convenience of the setter. The number corresponds with the location of the piece in the design, as indicated in Fig. 29, which is called a *setting plan,* or *setting drawing.* The different groups are lettered *A, B, C, D, E,* and *F,* but all similar blocks have the same number. Thus, all the blocks marked *A5* are in group *A* and are of the same size and pattern, and all blocks marked *B3* are of the same size and pattern. Any block marked *A4* can be taken from the pile and placed in any position marked *4* in the *A* section of the setting drawing.

STEEL

82. Construction.—Buildings of considerable height usually have a steel frame, which must be covered with masonry to protect it from the weather and from fire. The architect prepares the plans for a building, which show the location of doors, windows, etc., and also locates a steel framework to carry the entire building. The steel frame is then carefully designed by an engineer, special attention being given to strength and economy.

The frame of a steel-skeleton building consists primarily of a system of columns, with girders, beams, trusses, etc., between which or upon which the floors and roofs are built. In some cases the girders at each floor carry the masonry of the wall construction enclosing that floor.

83. The columns, girders, trusses, etc., are built up of structural shapes, known as I's, or I beams; L's, or angles; T's, or tees; channels, plates, bars, and rods. These shapes are built into columns, girders, trusses, etc., in the shop, after which they are assembled at the job to form a rigid framework.

84. Structural shapes are designated as to their size in inches, as 4″, 6″, 9″, etc., the dimensions referring to the depth, or largest dimension, of the shape. This dimension is frequently accompanied by a number indicating the number of pounds to the linear foot of the shape. Thus the marking *9″-I-21#* means an I beam, 9 inches in depth and weighing

21 pounds for each foot in length. The dimensions, weights, and other properties of shapes are standardized, and are given in handbooks issued by the leading steel companies.

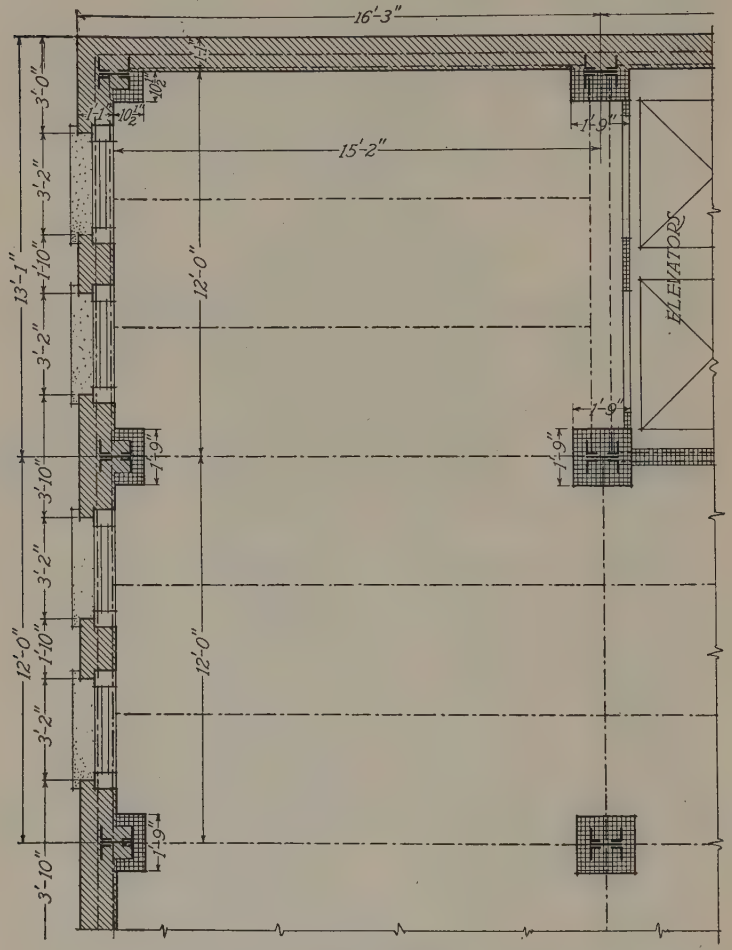


FIG. 30

85. Example of an Architect's Drawing.—In Fig. 30 is shown a typical plan of a corner of a steel-frame building,



Part of Floor Framing Plan

FIG. 31

the outside walls being brick, and the columns being covered with hollow tile and brickwork. The architect shows in his drawing only the indications of the columns which are accurately designed later on. The beams and girders used in the floor construction are not shown usually, although they are sometimes indicated by dot-and-dash lines, as in this illustration.

86. Example of Steel-Framing Plan.—In Fig. 31 is shown the framing plan for the same portion of the building shown in Fig. 30, the several columns being numbered for further reference. Drawings of this kind are generally prepared by engineers who specialize in this kind of work. No attention is paid in this drawing to the doors and windows, as there is no steel work in connection with them. Every beam is indicated as to its depth, and the weight per foot is also given, which describes the beam positively. Distances are given to column centers and to the centers of the beams and girders. The framing around the elevator shaft is shown, and this must correspond with the architect's design and the dimensions on the general plans.

The detail drawings of all the steel framing shown on this drawing are generally made by draftsmen employed by the contractor who erects the frame. These are submitted to the engineer and the architect for approval.

The columns are built from a plate and four angles riveted to it, and each column is numbered, as shown on the plans, for identification when it reaches the building. The floor construction consists of 9-inch **I** beams, weighing 21 pounds per linear foot, marked *a* and *d*, and are supported by girders in the outside walls and between the columns. The girders *b* each consists of a $\frac{3}{8}'' \times 5''$ plate and two 12-inch channels, as marked on the plans. Around the elevator shaft 12-inch channels are used to form the girders *e* and *f* which frame the opening and support the floor construction. Between the columns in the interior of the building are girders *c* consisting of 12-inch **I** beams. Tie-rods *g* are used to brace the floor beams, and to prevent the beams from spreading when the floor tiles are put in place.

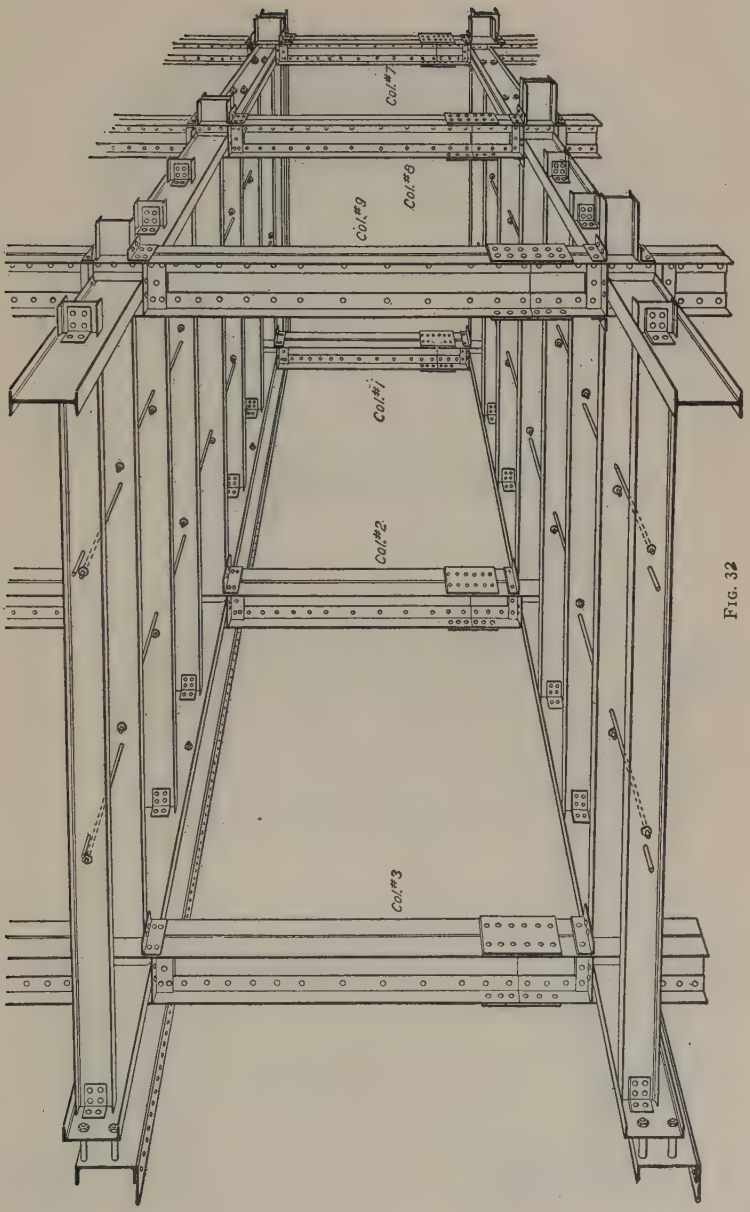


FIG. 32

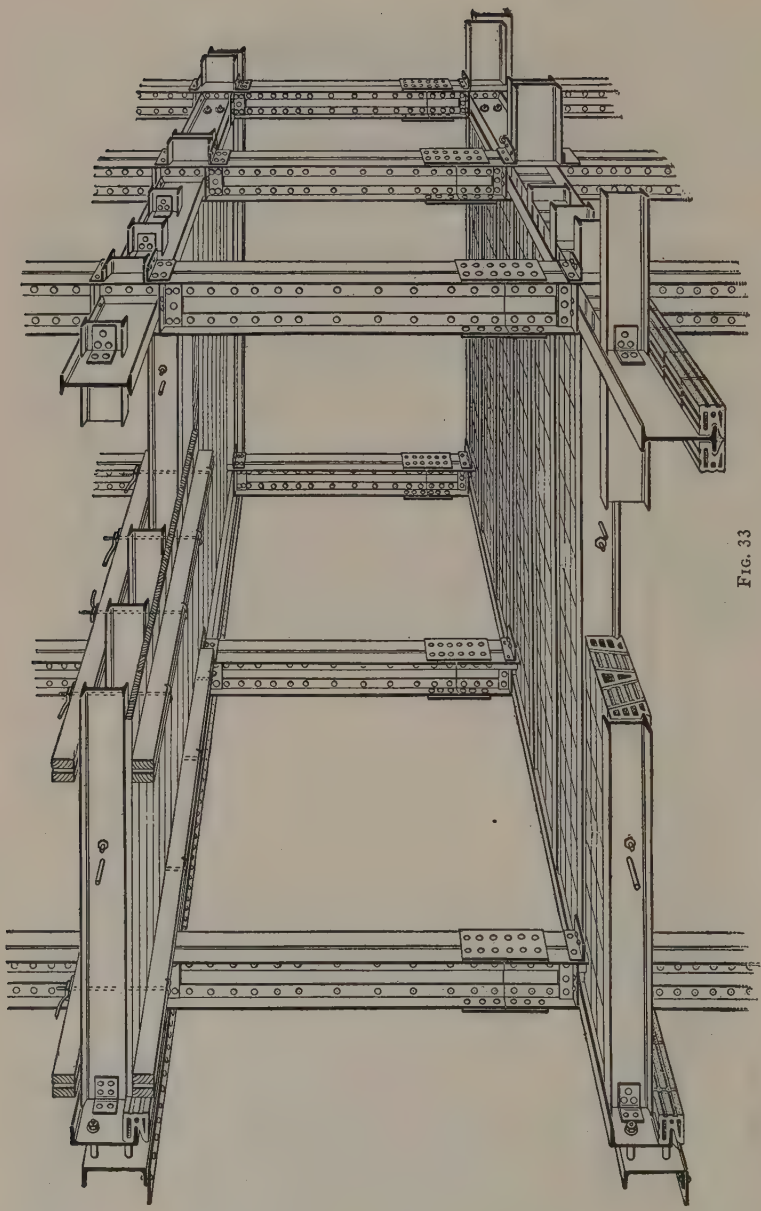


FIG. 33

FIG. 34

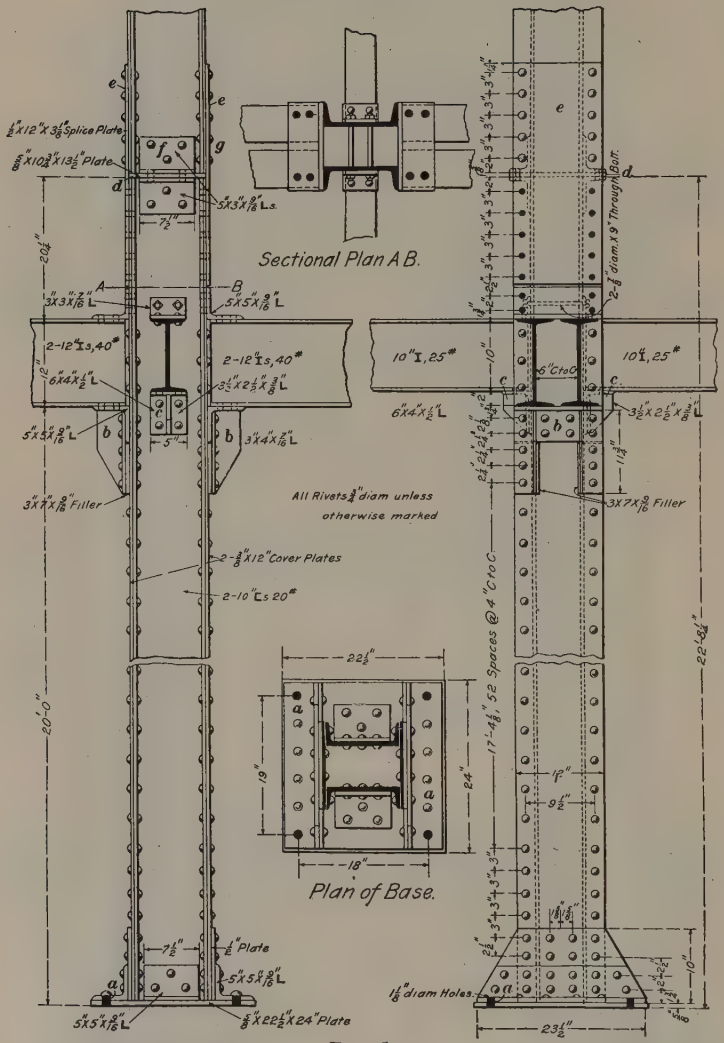

Sectional Plan A B.
Plan of Base.
All Rivets ⅞" diam unless otherwise marked
2-12"Is,40#
2-12"Is,40#
10"I,25#
10"I,25#
6"Cto C
2-⅞" diam. x 9" Through Bolt
3"X3"X⅜"L
5"X5"X⅜"L
6"X4"X½"L
5"X3"X⅜"L.s.
3½"X2½"X⅜"L
5"X3"X⅜"L
3"X4"X⅜"L
3"X7"X⅜" Filler
3"X7"X⅜" Filler
2-⅞"X12" Cover Plates
2-10"Cs 20#
52 Spaces @ 4"C to C
20'-0"
22'-6½"
22½"
19"
24"
18"
1"
9½"
7½"
1" Plate
5"X5"X⅜"L
⅝"X22½"X24" Plate
1⅛" diam Holes
23½"

FIG. 35

87. In Fig. 32 is shown a view of the steel work for the building shown in Figs. 30 and 31, before any of the fireproofing, walls, or floors, are started. In Fig. 33 the floor arches are in place, as well as the protection for the bottoms of some of the girders. The centering that supports the upper floor is shown. In Fig. 34 is shown the same building with the walls completed, the column fireproofing and the hollow-tile flooring in place, the sleepers ready for concrete filling and flooring, and the walls ready for plastering.

88. Typical Column Details.—In Fig. 35 is shown a typical detail drawing of a column such as is used in buildings similar to that shown in Fig. 34. Such a drawing would be made by the contractor. This column consists of two 10-inch channels, to which are riveted $\frac{3}{8}'' \times 12''$ cover plates, making a box-like column about 12 inches square. The base of the column is built out to make a $22\frac{1}{2}'' \times 24''$ base, the four corner holes being left open, as indicated by their being shown black, so as to allow for bolting the base to a masonry foundation.

On two sides of the column are knees, or brackets *b*, each of which supports two 12-inch **I** beams, while on the other two sides are smaller brackets *c*, each supporting a 10-inch **I** beam. The column is shown to be $22'\ 8\frac{1}{4}''$ long, and a bedplate *d* with splice plates *e* and angles *f* connects this section of the column to the section above it, making the column continuous throughout its height. The joint is usually made just above a floor line, as at *g*, so as to avoid complicated framing at the floor level.

89. As all of the steel work for a building must be detailed in this manner before the actual work of fabrication can commence, it is evident that the drawings must be accurately made, and care must be taken in the preparation of the material in the shop.

All of the drawings of the steel work are submitted to the architect and the engineer for their approval before the work of fabrication is commenced. The architect checks such dimensions as column centers, story heights, etc., in order to see that there is ample room for the design of the building to be carried

out, and to permit the workmen of different trades to do their work. The engineer examines the drawings to see that the joints are properly designed for strength.

CONCRETE

90. Representation of Concrete Construction. Architect's drawings for concrete buildings, which may be of concrete blocks, monolithic concrete, or reinforced concrete, differ from drawings for buildings made of stone, brick, or tile, only in the indication used to represent the materials. A concrete wall is shown in Fig. 36 (*a*), and a portion of a concrete wall with a reinforced-concrete column is shown in Fig. 36 (*b*). The method of representing concrete is shown in Fig. 11, at *c* in section and at *o* in elevation. No indication is used on plans to represent plaster on the inside, unless the wall is furred and lathed, when an additional line is shown, as already described for other forms of masonry walls. The nature and amount of reinforcement are seldom stated on the general plans, such as Fig. 37, which are made by the architect; but the reinforcement is shown on the scale details or on special drawings for the concrete work. In many cases the architect employs a concrete engineer to prepare the drawings showing this work.

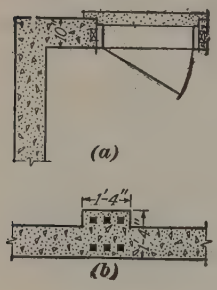


FIG. 36

91. Example of a Working Plan for a Reinforced-Concrete Building.—An example of a portion of a plan prepared by a concrete engineer is shown in Fig. 38. This plan shows the concrete construction required for the architect's plan shown in Fig. 37, and is to be used as a working drawing for the concrete work only. On this drawing the various columns, girders, beams, etc., are shown, each being numbered so that it may be identified in accompanying schedules, such as are shown in Fig. 39 (*a*) and (*b*). For convenience in identifying the structural members in Fig. 38, the girders are indicated by the

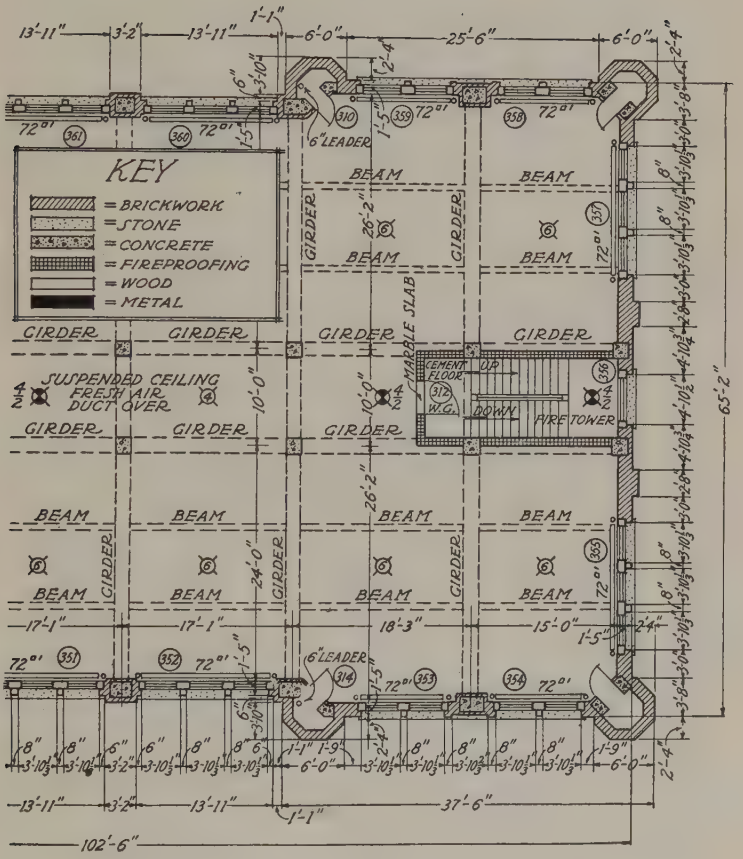

KEY
= BRICKWORK
= STONE
= CONCRETE
= FIREPROOFING
= WOOD
= METAL
BEAM
GIRDER
MARBLE SLAB
SUSPENDED CEILING
FRESH AIR
DUCT OVER
CEMENT FLOOR
DN
W.C.
DOWN
FIRE TOWER
6" LEADER
72°
13'-11"
3'-2"
1'-1"
6'-0"
25'-6"
65'-2"
102'-6"
37'-6"

FIG. 37

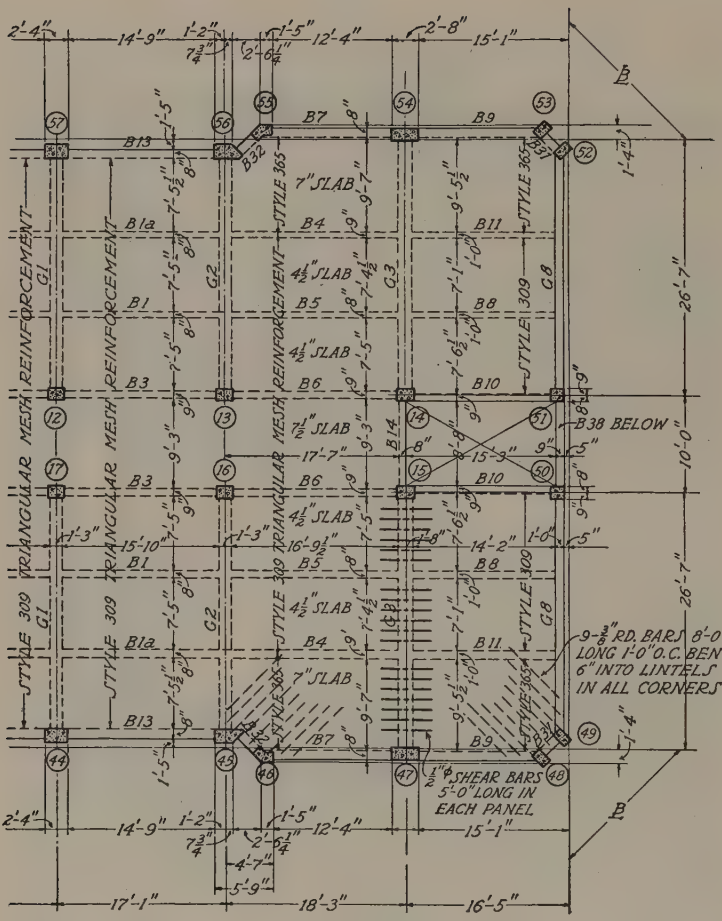

7"SLAB
4½"SLAB
7½"SLAB
TRIANGULAR MESH REINFORCEMENT
STYLE 309
STYLE 365
B38 BELOW
9-⅜" RD. BARS 8'-0" LONG 1'-0" O.C. BENT 6" INTO LINTELS IN ALL CORNERS
1" ø SHEAR BARS 5'-0" LONG IN EACH PANEL

FIG. 38

BEAM SCHEDULE – SECOND AND THIRD FLOOR

MK.	TL. Nº	SIZE a	b	c	d	REINFORCEMENT DB	Straight	Stirrups	Top Steel	SK. Nº	NEAR COL.	REMARKS
B1	12	8"	2'-0"	4½"	4½"	1-1"Sq.	1-1"Sq.	12-⅜"Rd.	2-⅞"Rd. Rods in Top of all Beams	1	25-35	
B1a	12	8"	2'-0"	4½"	5½"	1-1"Sq.	1-1"Sq.	12-⅜"Rd.		1	25-35	
B2	8	8"	1'-7"	5½"	0	1-1"Sq.	1-1"Sq.	12-⅜"Rd.		2	34-35	
B3	12	9"	2'-0"	4½"	7½"	1-1⅛"Sq.	1-1⅛"Sq.	12-⅜"Rd.		1	24-25	
B3a	2	9"	2'-0"	4½"	7½"	2-1"Rd.	2-1"Rd.	12-⅜"Rd.		1	23-24	
B4	4	9"	2'-0"	7"	4½"	2-1"Rd.	2-1 Rd.	14-⅜"Rd.		1	28-32	
B5	4	8"	2'-0"	4½"	4½"	2-⅞"Rd	2-⅞"Rd.	14-⅜"Rd.		1	28-32	
B6	4	9"	2'-0"	4½"	7½"	2-1"Rd.	2-1"Rd.	14-⅜"Rd.		1	27-28	
B7	4	8"	1'-7"	7"	0"	2-¾"Rd.	3-¾"Rd.	12-⅜"Rd.		4	30-31	
B8	4	1'-0"	1'-6"	4½"	4½"	2-1"Rd.	2-1"Rd.	12-⅜"Rd.		1	73-30	
B9	4	8"	1'-7"	7"	0"	2-¾"Rd.	2-¾"Rd.	12-⅜"Rd.		4	29-30	
B10	4	9"	2'-0"	4½"	0"	1-⅞"Rd. 1-1"Rd.	1-⅞"Rd. 1-1"Rd.	12-⅜"Rd.		1	1-72	

(a)

GIRDER SCHEDULE – SECOND AND THIRD FLOOR

MK.	TL. Nº	SIZE a	b	c	d	REINFORCEMENT DB	Straight	Stirrups	Top Steel	Shear Bars	SK. Nº	NEAR COL.	REMARKS
G1	12	1'-3"	2'-8"	4½" 5½"	4½" 5½"	4-1⅛"Sq.	4-1⅛"Sq.	18-⅜"Rd.	2-⅜"Rd.	18-½"Rd.	1	33-26	See Sk. 10 Sh. 3
G2	4	1'-3"	2'-8"	4½" 7"	4½" 5½"	4-1⅛"Sq.	4-1⅛"Sq.	18-⅜"Rd.	4-⅞"Rd.	18-½"Rd.	1	27-32	
G3	4	1'-8"	2'-8"	4½" 7"	4½" 7"	5-1⅛"Sq.	5-1⅛"Sq.	20-⅜"Rd.	5-1"Sq.	18-½"Rd.	1	28-30	
G4	2	1'-3"	2'-8"	4½" 5½"	0" 5½"	3-1⅛"Sq.	4-1⅛"Sq.	18-⅜"Rd.	4-1"Sq.	18-½"Rd.	1	23-36	
G5	2	1'-3"	3'-2"	0" 5½"	4½"	3-1⅛"Sq.	4-1⅛"Sq.	18-⅜"Rd.	4-1"Sq.	18-½"Rd.	1	22-37	
G6	2	1'-0"	2'-4"	0	4½"	2-1⅛"Sq.	2-1⅛"Sq.	14-⅜"Rd.	2-⅜"Rd.	18-½"Rd.	1	62-7a	
G7	2	1'-3"	2'-8"	4½" 5½"	4½"	1-1⅛"Sq.	1-1⅛"Sq. 1-⅞"Rd.	14-⅜"Rd.	2-⅜"Rd.	12-½"Rd.	6	63-6a	
G8	4	8"	3'-6"	0	4½" 7"	2-1⅛"Sq.	2-1⅛"Sq.	20-⅜"Rd.	3-1"Sq.	18-½"Rd.	3	73-74	

(b)

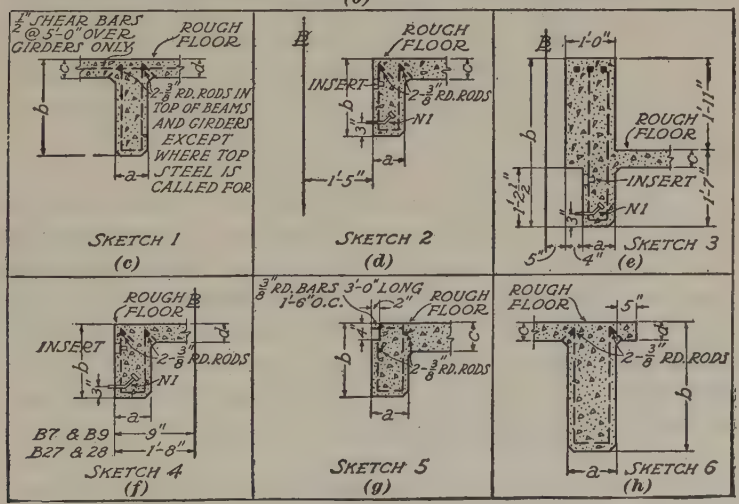


FIG. 39

letter *G*, and the beams by *B*, followed by suitable letters and numbers. The columns are marked by numbers in circles.

Sometimes the sizes of the beams and girders are placed on the drawings in connection with the structural members shown on the framing plan. In this case, however, the girders and beams are marked with letters and numbers as previously mentioned, and are described as in the schedules (*a*) and (*b*), Fig. 39. Consequently, all beams of the same size are marked with the same letter and number throughout the plans, and are described under the same letter and number in the schedule. Thus, when *G1* is found in the plan, a corresponding reference to *G1* will be found in the first column of the girder schedule. In this schedule will be given the total number of the girders marked *G1*, the sizes, reinforcement, the columns between which the girder extends on the plans, and a reference to a sketch which is a diagram showing the shape of the girder. In the case of girder *G1*, sketch *1* is indicated. This sketch is shown in Fig. 39 (*c*). It will be noted that there are letters *a*, *b*, *c*, and *d* in place of dimensions in this sketch. Under the heading *Size* in the girder schedules, opposite the letter *G1*, the dimensions corresponding to these letters will be found. For instance, the distance *a* in Girder *1* is 1′3″, the distance *b* is 2′8″, etc. The distances *c* and *d* show that the slabs on each side of this girder vary in size, and may be either 4½ or 5 inches. The actual thickness at any given point can be determined from the plan. Under the head of Reinforcement in the girder schedule and opposite *G1*, will be found a list of the bars or rods which are required in the construction of this girder. Under the head *DB*, meaning *down bars*, there are 4 bars 1⅛″ square; under *Straight*, 4 bars 1⅛″ square, etc. This will give a sufficient idea of this method of indicating girders, beams, etc. The same explanation applies to the beam schedule. In the case of *B1*, *B1a*, *B3*, *B4*, *etc.*, sketch *1* is also applicable, and the dimensions are taken off in the same manner as with girders.

92. In the plan shown in Fig. 38, various kinds of mesh reinforcement are indicated, such as *style 309*, and *style 365*. Diagonal reinforcement is indicated at the corners near col-

umns, *45, 46, 48,* and *49*. Between columns *15* and *47* are shown heavy dash-and-dot lines, which indicate the tension members of the reinforcement used for the floor slabs. The diagonal cross lines between columns *14, 15, 50,* and *51* indicate an open space. By referring to the architect's plan, Fig. 37, it will be seen that this space is occupied by a stairway. A careful study of these drawings will give a very clear idea of the methods of indicating construction and material on plans for concrete buildings.

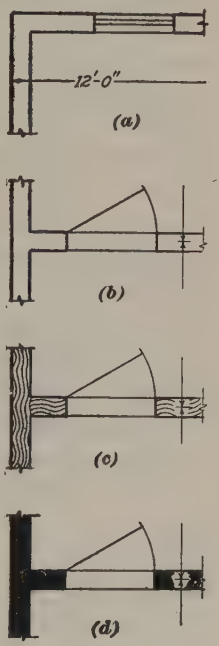


FIG. 40

FRAME BUILDINGS

93. Frame Walls.—Frame walls are built usually with either 2″×4″ or 2″×6″ studs. On the outside of these studs, when siding is used, a surface of sheathing boards about 1 inch thick is placed, over which the finished siding is laid. On the inside of the building, the thickness of the plaster, including the lath, is a little less than 1 inch. The thickness of the wall when 2″×4″ studs are used, will thus be between 6 inches and 7 inches, and between 8 inches and 9 inches when 2″×6″ studs are used. Thus, in Fig. 40 (*a*) the frame wall is shown about 7 inches thick, at the $\frac{1}{4}$-inch scale indicating that 2″×4″ studs are used with sheathing and siding on the outside and plastering on the inside. The thickness of frame walls is seldom given on drawings, as it may vary somewhat on account of variation in the thickness of the materials, as just mentioned. The dimensions are, therefore, taken to some fixed point, such as the outside of the studs or the outside of the sheathing. There is a variation in practice among architects with respect to the point to which such measurements are taken. To determine which is used, the overall dimension of one side of the basement plan and

the corresponding dimension of the first-floor plan should be compared, and if they are alike the architect has probably taken his distances for the first-floor plan from the outside of the sheathing. If, however, the dimension in the first-floor plan is 2 inches less than in the basement plan, the architect has taken his dimensions from the outside of the studs.

94. The building shown in the blueprints which accompany this Section has an outside covering of stucco. In this construction, the studs are first sheathed with 7/8-inch sheathing over which furring strips are placed and to which metal lath is applied. The surface of stucco brings the total construction to a thickness of $2\frac{1}{2}$ inches outside the studs. As it is clear from the elevations and scale drawings, that this construction is carried out over the entire building, there need be none of this detail shown in the general plans and sections, excepting the inside and outside lines of the walls. The measurements of the frame of this building are taken from the outside of the studs and, therefore, are 5 inches smaller in each direction than the basement walls.

95. Partitions, or Inside Walls.—Frame partitions are built up usually of $2'' \times 4''$ studs with lath and plaster on both sides, making a total thickness of $5\frac{1}{4}$ inches to 6 inches, depending on the width of the stud and the thickness of the plaster. Such partitions are, however, shown on the plans as being 6 inches. The dimensions which locate the partitions are given usually to the centers of the partitions, which will be the center of the studs, and any difference in thickness is, therefore, divided between the rooms on both sides of the partitions, without materially affecting their size or proportions. Such a partition is indicated in Fig. 40 (*b*).

96. Sometimes, to save room, a partition is erected with the studs flatwise, so as to take up only 2 inches in the thickness of the wall, making a partition somewhat less than 4 inches thick. Such a partition is shown at *d* on the blueprint of the First Floor Plan. This construction may be used where no weight comes on the partition or where the partition is short, as between closets. When studs are set flatwise the thickness of the par-

tition should be especially marked on the plan, as at *d*. In other cases, the partition is made thicker, as at *e*, in order to continue the thickness of the partition at the colonnade between the hall and the living room, or to accommodate sliding doors, as at *f* between the hall and the dining room. In such cases it is customary to place a row of studs for each side of the partition, and the partitions are measured to the outside edge of the studs, and sometimes to the finished plaster surfaces. In other cases, as at *g*, the partition is made thicker to cover large pipes or other work in the partition. In this case there is a 4-inch soil pipe, having an outside size of $5\frac{1}{2}$ inches in the partition. A 2-inch vent or waste pipe, being only $3\frac{1}{2}$ inches over all, will readily be concealed in a $2'' \times 4''$ stud partition.

97. Walls and partitions of wood-frame construction are indicated usually with the interior spaces entirely blank, as in (*a*) and (*b*), Fig. 40, or with wavy lines, as in (*c*). Some architects shade or darken the walls, as in (*d*), so that they will appear in a lighter blue color, or entirely white, in the blueprints. Formerly it was the custom to color these spaces to represent the various materials, as already mentioned, but this custom has gone out of use, as the method of producing blueprints makes it advisable to make all the indications so that they can be reproduced by blueprinting.

98. Floors and Roofs.—Floors and roofs have their construction shown in the sections, or in the scale details. When the section is taken at right angles to the joists, the joists are shown in section with a notation of the size of the joists and their spacing on centers, as at *g* in the blueprint of the Transverse Section. The side view of the bridging is shown between the joists. When the section is taken lengthwise of the joists, ceiling beams, or rafters, the space occupied by them has usually a notation regarding the size and centering, the same as when the joists are at right angles to the section. An example of this is shown at *d* in the Longitudinal Section. Where bridging occurs, it is shown as vertical parallel lines, as at *e*. The size, direction, and spacing of the joists are generally indicated on the floor plans by arrows, as shown on the blueprint plans.

Rafters are sometimes shown as at *f* in the Longitudinal Section.

99. Brick-Veneered Walls.—Brick-veneered walls consist of a sheathed wooden frame, outside of which is a 4-inch facing of brick. The general construction of such a wall is shown in perspective in Fig. 41. The frame wall occupies a space of 6 inches, including the sheathing and the inside plas-

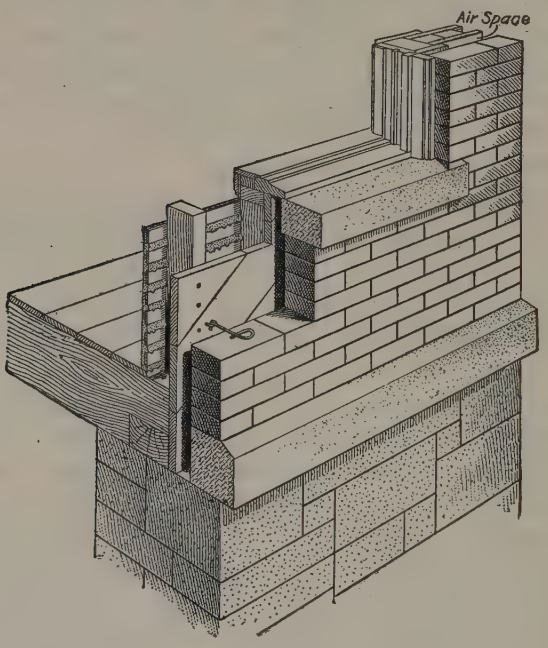


FIG. 41

tering. The brick is placed with a 2-inch air space between it and the sheathing, making a total thickness of about 12 inches. The frame for supporting the brick veneer is sometimes made of 2″×6″ studs, in which case the wall will be 2 inches thicker than shown, or about 14 inches over all, of which thickness the frame wall occupies 8 inches. For very cheap work the sheathing is sometimes omitted, the brick wall being anchored to the edges of the studs, but this construction is not to be recommended.

Brick-veneered walls are shown in plan in Fig. 42, in which *a* is the brick veneer, *b* is a 2-inch air space, and *c* is a frame wall consisting of 2″×4″ studding with sheathing boards on the outside, and lath and plaster on the inside, the construction being the same as shown in Fig. 41.

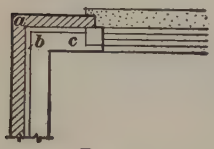


Fig. 42

100. A brick-veneered wall is similar in appearance to a solid brick wall, and any of the face bonds shown in Fig. 21 may be used in brick-veneered work.

Dimensions for brick-veneered walls are given usually to the outside face of the brick, and the studs must be kept back a sufficient distance to allow for the brickwork, and for the air space between the brick and the sheathing.

OPENINGS IN WALLS AND PARTITIONS

101. Plain Openings.—Plain openings that are similar to door openings are shown in plan as in Fig. 43 (*a*) and (*b*). Such openings have a portion of the wall extending across the top, which is indicated by broken lines. An opening of this type may be finished in plaster all around, or it may be finished with wooden jambs and trim like an ordinary door. When trimmed with wood, the opening is sometimes marked *Cased Opening*, as in (*a*), and when the top, or head, is arched, it is marked *Arched Opening*, as in (*b*).

DOORS

102. Common Swinging Doors.—In Fig. 43 (*c*) is an indication of a single swinging door in a stud partition. The slanting line *a* or a line *b* shows the door and indicates on which side of the opening the door is hung. As a rule, the finished dimensions of the door are marked on it, the width being marked first and then the height, and sometimes the thickness. The door is occasionally numbered, as indicated in the figure, for

reference in the specifications, or in large-scale details. A method of numbering doors is indicated in Fig. 37. In this example, the numbers are placed in circles, as close to the doors as possible. Each of these numbers begins with a 3, which indicates that the door is on the third floor of the building.

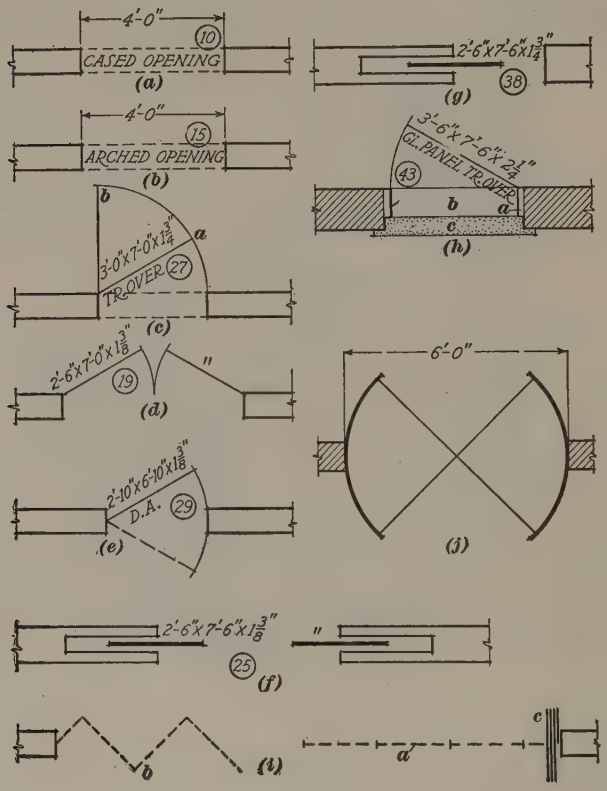


Fig. 43

The manner of indicating a common swinging door in elevation is shown at *h* in the blueprint of the Transverse Section.

103. Transoms.—Doors sometimes have openings above them called *transoms,* in which are sash or panels that can be opened separately for ventilation. In hotels and other places

the transom is sometimes made with a wood panel, so as to prevent observation through it, while in others the panel is glazed for lighting the corridor. The customary method of indicating a transom over a door is to use the abbreviation *Tr.* or *Tr. Over* on the plan as in Fig. 43 (*c*). The details of these transoms are generally shown on the scale details.

104. Double Doors.—An opening may be closed by a pair of doors hung from the two jambs as in Fig. 43 (*d*). Usually the size is marked on one door only, as the doors are of the same size. In some cases a ditto mark (") is used to indicate that the doors have the same dimensions.

105. Double-Acting Door.—An indication of a double-acting door is shown in Fig. 43 (*e*). The letters DA are frequently omitted. This door swings in either direction through the opening and is generally controlled by a spring that holds the door, while at rest, in a closed position in the opening. In the blueprint of the First Floor Plan two such doors are shown leading out of the pantry. Double doors may be double-acting also, that is, both doors may swing back and forth through the opening.

106. A Double-Sliding Door.—A double-sliding door is indicated in Fig. 43 (*f*). The partition, which is a stud partition, is made about 11 inches in thickness to accommodate the sliding doors, and the doors slide into pockets that are formed in these partitions. The doors between the dining room and the hall in the blueprint of the First Floor Plan are sliding doors, and the method of showing this indication is quite clear. As with other doors, the sizes of the individual doors are marked on the drawing. A single sliding door is like one of a pair of sliding doors and is indicated as in Fig. 43 (*g*).

107. Door in a Masonry Wall.—A door in a brick or other masonry wall is indicated as in Fig. 43 (*h*). This indication shows the door jambs at *a*, the wooden sill at *b*, and a stone or cement sill at *c*.

The numbers in the circles at most of these doors are used when the doors are numbered on the plans.

108. Accordion Door.—An accordion door, such as is used between lecture rooms, etc., is shown in Fig. 43 (*i*). This door consists of a number of leaves hinged together and supported on pivoted rollers or hangers moving along an overhead

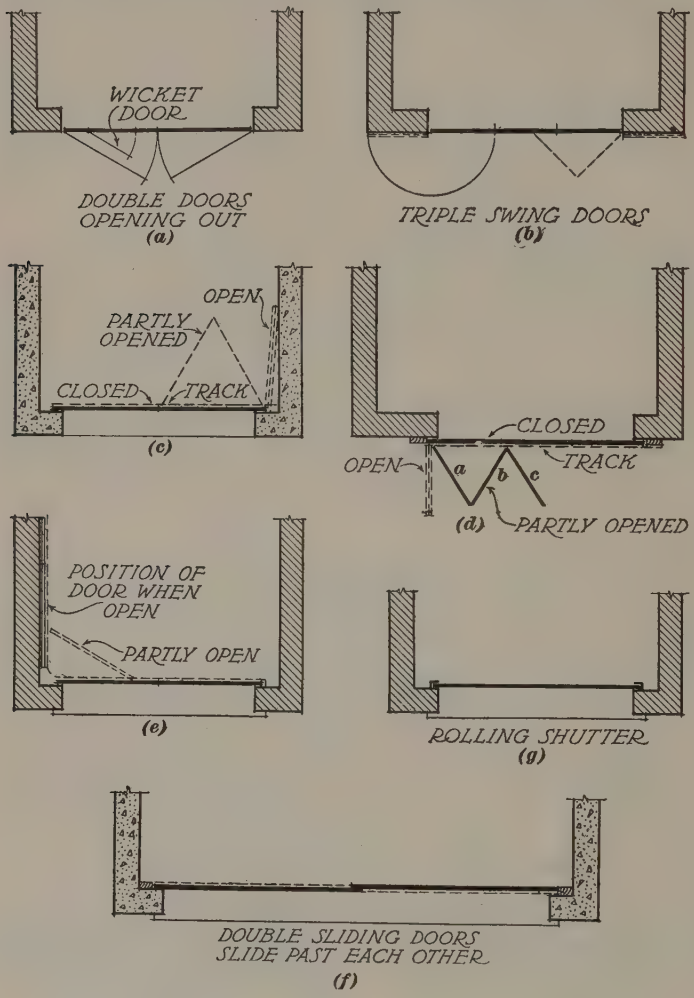


FIG. 44

track. In some cases the doors are used in two groups to meet in the center of the opening. When closed, this type of door presents a plain paneled surface, and when open, folds close against the jamb of the opening in the wall or into a pocket. At *a*, the dotted line indicates the door as closed, the other half, as at *b*, being partly open. At *c* the door is shown opened and fitting close against the jamb of the opening.

109. Revolving Doors.—A revolving door, indicated as shown in Fig. 43 (*j*), is used at entrances to public buildings, where the doors are in constant use, and it is desired to prevent drafts and loss of heat.

110. Garage Doors.—Small or private garages may have doors of any one of many styles, depending on the space available for doors. Swinging doors usually open out, so as to economize space. Fig. 44 shows several methods of hanging doors.

In (*a*) is shown a double door opening out, each door being hinged to the jamb. A small door, called a *wicket door,* is built in the left-hand door. In (*b*) is shown a triple door, two of which are hinged to the jambs, while the center one may be hinged to either of the other doors. In (*c*) is shown a double door sliding on an inside track, the hangers being provided with swivels to permit the doors to fold up, as shown. In (*d*) is shown a triple door hung on the outside, two doors *a* and *b* sliding as in (*c*), the third door *c* being hinged to the middle door. In (*e*) the double doors are shown to slide around the corner to lie close against the side walls, requiring very little inside space. As shown in (*f*), the doors for a double garage slide past each other, so that either half of the front may be opened. This method is suitable for double garages where both doors need not be open at the same time. In (*g*) is shown a rolling steel shutter which slides in grooves on the jambs, and rolls up into a metal casing above the door.

Still other devices are available for particular situations, and most of them are patented. The particular kind of door used should be clearly specified and the drawing should show that the proper construction has been provided to receive the door.

WINDOWS

111. In Fig. 45 are shown indications of different types of windows as they appear on plans and sections. Windows are often numbered on the plans in the same manner as are doors, the numbers being placed in circles, as close to the windows as possible. This method of numbering is shown in Fig. 37. In

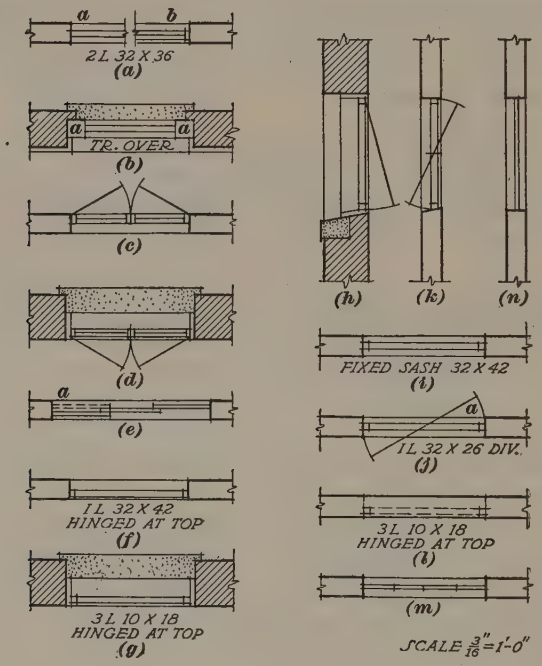


Fig. 45

this case each of the numbers begins with a 3, which indicates that the window is on the third floor of the building.

112. Double-Hung Windows.—In Fig. 45 (*a*) is an indication of a double-hung window in the outside wall of a frame building. The sash may be shown as at *a*, or as at *b*. Indications of such windows can be found on the blueprints of the Plans, and the appearance of the exterior of such windows

can be seen in the corresponding parts of the Elevations. The interior appearance of these windows is shown in the Sections. Either the size of the sash opening or the size of the glass may be shown, the custom varying in different parts of the country. In the blueprint of the South Elevation, the sizes of the openings are shown; in Fig. 45 (*a*) the method showing the size of the glass is used, and the marking gives the number of lights and their size, the width of the light being given first.

113. Double-Hung Windows in a Masonry Wall. In Fig. 45 (*b*) is an indication of a double-hung window in a brick wall. This indication is used with any masonry wall, the only difference being in the manner of indicating the material of which the wall is composed, as stone, tile, or concrete. Double-hung windows in masonry walls must be provided with boxes *a* to contain the weights that counterbalance the sash. To accommodate these boxes, a jog, or rabbet, is built into each jamb or side of the masonry opening, or else the frame is first set and the masonry built against it. The stone sill projecting at the top of the drawing shows that it is the outside of the wall. The inside of the wall is indicated by the line showing the furring and plastering.

114. Casement Windows.—In Fig. 45 (*c*) and (*d*) are shown casement windows, that is, windows that have pairs of sash that are hung at the sides like doors. The casement windows have their sills some distance above the floor line, somewhat similar to double-hung windows. The indication in (*c*) shows a casement window in a frame building, the sash being shown opening out of the room. In (*d*) is shown a casement window in a masonry wall, the sash being shown opening into the room.

115. French Windows.—French windows are windows having pairs of sash hung at the sides similar to casement windows, except that they extend down to the floor level, forming door-like features. French windows are shown in the blueprint of the First Floor Plan, at the opening from the living room to the side porch, and from the dining room to the breakfast porch.

On the blueprint they are marked *Doors*. The indications are the same as for casement windows.

116. Sliding-Sash Windows.—Sash that slide horizontally are sometimes used, as in sleeping porches, when it is desired to open more than half of the window space. A method of indicating such a window is shown in Fig. 45 (*e*).

117. Single-Sash Windows.—When the opening is not large enough to permit the use of double-hung or casement sash, single-sash windows are used. These windows may be hinged at the side, top or bottom, and are indicated in plan as in Fig. 45 (*f*) when in a frame wall, and as in (*g*) when in a masonry wall. In (*h*) is shown a vertical section of the window shown in plan in (*g*), the sash being hinged at the top. When the sash is hung from the top, bottom or sides, the drawing should be marked *hinged at top*, etc., as the case may be. Single sash are generally shown close to the inside of the wall, and are very commonly used in basements of buildings.

118. Single-sash windows may also, if desirable, be fixed so as not to open. In such cases, it is customary to mark them *fixed sash* as in Fig. 45 (*i*). Single sash are very frequently pivoted so as to swing either horizontally or vertically on pivots placed at the middle of the sash. When pivoted on a vertical axis, they are indicated in plan as in (*j*). When pivoted on a horizontal axis, they can be shown in section as in (*k*).

119. Single-sash windows are frequently placed high up in the wall, so that a piece of furniture can be placed against the wall under them, or so that people cannot look through, but at the same time the window can be used to ventilate the room. The sash is then shown dotted, as in Fig. 45 (*l*). Such windows are shown in the kitchen in the blueprint of the First Floor Plan, the window being placed high up, as shown at *i* in the Transverse Section, so that servants cannot look out on the rear porch, and so that a table may be placed against the wall below the window.

120. Single sash are sometimes used as transoms over windows in outside walls, in which case the indication appears with

an added notation, giving the size of the glass or such information as will lead the contractor to examine the elevations or specifications. An indication of a transom is given in Fig. 45 (*b*).

121. Interior Sash.—Interior partitions are sometimes constructed with sash for lighting corridors or other parts of a building. Such a partition is indicated on the plans in the manner shown in Fig. 45 (*m*) and in section as in (*n*). Partitions of this nature are usually detailed, in order to show the moldings and the sizes of glass.

122. Blinds.—Windows are sometimes equipped with blinds, or shutters, hinged at the sides of the frame, as shown on the blueprint of the South Elevation, at *j* and *k*.

FIREPROOF WINDOWS

123. As a protection against fire, windows for industrial buildings or in places where there is an unusual fire hazard, are often made of metal and glazed with wire glass. The design of the sash may follow closely the style of wooden sash, particularly if sheet metal is used, so the indication of the window on the plans will be similar to that already shown for wooden frames and sash. It is customary, however, to mark the window, so that its construction will be readily understood, with such words as *Metal Sash, Wire Glass,* etc., as in Fig. 46 (*a*), so as to identify it for further description in the specifications. An elevation of this type of window is shown in (*b*).

124. Steel Sash.—Some window openings, particularly very large openings, such as occur in large factory plants which require the maximum of light, are equipped with sash made of rolled-steel shapes and glazed with wire glass. These windows, or sash, may extend from floor to ceiling, and from column to column in the outside walls, as indicated in Fig. 46 (*c*), or the sash may extend in a practically unbroken surface from end to end of the building, as indicated in (*d*). Portions of the sash are made to swing or hinge for ventilation. These windows are

better shown on an elevation, as in (*e*), which shows the sash between columns as in (*c*). In (*f*), which shows an elevation of (*d*), the sash extends in a continuous line across the face of the columns. The portions shown with diagonal lines are hinged or pivoted. The glass used for this type of window is

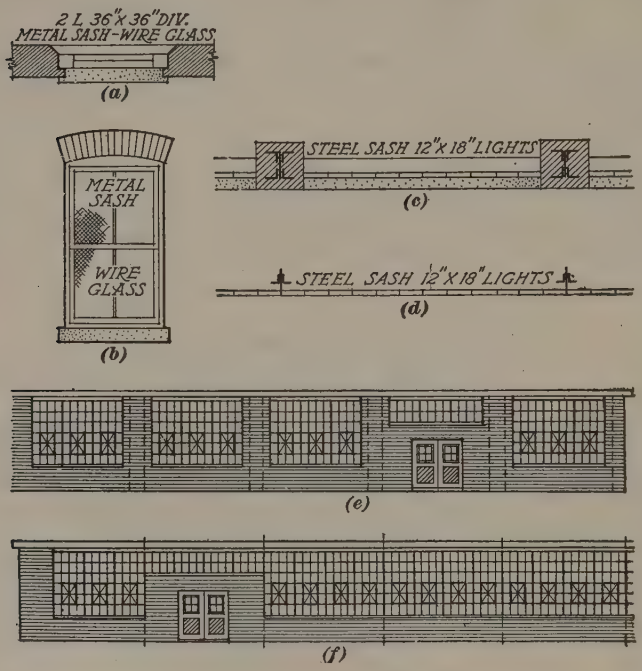


Fig. 46

usually 10″×16″, 12″×16″, or 14″×20″, although other sizes may be used when desired. Several patented types of these windows are available. The architect may show these windows in scale details, or he may depend on the general plans and a description in the specifications.

The blueprints referred to in "Specification Writing," Part 2, are reproduced in this book in reduced size in black, and the set is grouped at the end of Section 58.

READING ARCHITECTS' BLUEPRINTS
(PART 2)

INDICATIONS USED IN DRAWINGS
(Continued)

INDICATIONS OF INTERIOR WOODWORK

VARIOUS FEATURES

1. Finish or Trim.—Interior woodwork consists of the woodwork used to finish or trim the building, and includes base, chair rail, picture molding, etc. It consists of thin strips of wood molded into pleasing shapes, and is often not more than 1 inch in thickness. For this reason it is seldom shown or indicated on the floor plans, but it is seen in sections where the broad faces of the work are exposed. Thus, in the blueprint* of the First-Floor Plan, there are no indications of base or picture molding, although they appear at *g* and *h* in the Longitudinal Section. Interior woodwork consists largely of molded surfaces, and the outlines of these moldings are shown in section on the scale details or full-size details, as was illustrated in Fig. 4 of *Reading Architects' Blueprints*, Part 1. The kind of wood, and other information, is given in the specifications.

*As occasion requires, reference will be made to the set of blueprints of a dwelling furnished with *Reading Architects' Blueprints*, Part 1. The same references will apply to the corresponding set of plates that are bound in this Part.

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2. Doors.—Doors are shown on general plans by heavy lines, as already described, or they may be shown on elevations as in the blueprint of the South Elevation, at *l*, or in sections, as at *h* in the Transverse Section. The doors may be shown on scale details and parts of doors may be shown on full-size details.

3. Built-In Features.—Work in the nature of book cases, mantels, kitchen and pantry dressers, etc. is frequently made to be fixed in place in the building. Such work may be made more or less completely in the shop, and then erected in place. These features appear on the general plans, as at *h*, *i*, and *j*, in the blueprint of the First-Floor Plan, and scale details are made to guide the contractor and the workmen. In some cases, working drawings are made by the carpenter contractor. The same method is followed with colonnades, arches, and similar work. Scale details showing interior woodwork are shown in Figs. 3 and 4 of *Reading Architects' Blueprints*, Part 1, and further descriptions of this kind of work will be found in Part 3 of the same subject, which follows this Section.

STAIRS

4. General Considerations.—More mistakes are made in the drawing and arranging of stairs than of any other part of the building. It is, therefore, very important to be able to determine from an inspection of the plans whether sufficient space has been allowed for the stairs. This space should be sufficient to accommodate a series of steps of such a size as to be comfortable for ordinary use, and also so arranged that the distance between any step and the construction above the steps will be sufficient so that an adult walking up or down the stairs will not come in contact with the overhead construction.

5. Headroom.—The distance between the steps and the construction directly over them is known as *headroom*, and should not be less than 7 feet. The subject of headroom

is illustrated in Fig. 1, where a flight of stairs is shown in section. The floor construction *a* extending over the lower steps is called the *header*, and the steps consist of *treads b* and the *risers e*. At no point should the headroom be less than shown between the tread *b* and the overhead part *a*. If the construction *a* were to extend further over the stairs below

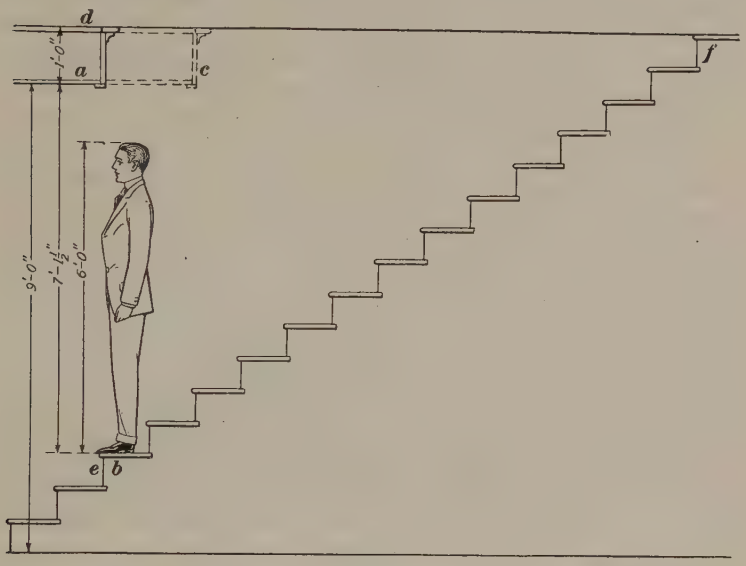


Fig. 1

as at *c*, it would be impossible for a person to walk up or down these stairs without stooping or striking the construction above.

It will be seen in Fig. 1, that if the ceiling height is 8 feet 10½ inches, the stairs cannot extend more than three risers under the header *a* before the minimum headroom is obtained. The header must always be located at a sufficient distance horizontally from the top riser *f* so that the vertical distance between the header *a* and the tread directly below it, as at *e*, will be not less than 7 feet. If the height of the risers is known, it is possible to determine over which riser there will be such headroom and the header can be located accordingly.

The number of such risers, counted from the top, may be found by the following rule:

Rule.—*To the proper headroom, 7 feet, add the thickness of the floor construction, and divide the sum by the height of one riser. The result will be the least allowable number of risers from the floor above to the riser directly below the header.*

For example, if in Fig. 1 the height of the riser is $7\frac{1}{2}$ inches, according to the rule the nearest that the header could be to the top of the stairs would be over the thirteenth riser, counted from the top, and preferably it would be placed over the fourteenth, as shown in the illustration.

6. In some cases the stairs are placed directly over each other, as at *m l* in the blueprint of the First-Floor Plan. In such cases, approximately one-half of the stairs ascending from the first floor, and a portion of the stairs descending from the first floor, are shown in the same plan. A broken line *n* is shown across these stairs where these indications meet. Whether there is sufficient headroom for stairs so shown can be determined by counting the number of riser lines on the plan. If the treads and risers are of the customary size, there should be at least thirteen risers between the first ascending riser and the first descending riser.

7. In case it is found, when the stairs are tested by the foregoing rules, that sufficient headroom has not been provided, the architect should be notified, so that he may examine the indications of the stairs to see if the design is correct.

8. Number of Treads and Risers.—The number of risers for any flight, as well as the height of the riser, is determined in the following manner: Let it be assumed that the height of the story, from floor to floor, is 10 feet 5 inches and that it is desired to have a riser approximately $7\frac{1}{2}$ inches in height. The height of the story, 10 feet 5 inches, or 125 inches, is then divided by $7\frac{1}{2}$, and the result is found to be $16\frac{2}{3}$. This would mean that sixteen and two-thirds risers of this height would be required. As it is obviously impossible to use two-thirds of a riser, either sixteen or seventeen risers

of equal height must be used. Dividing the story height 125 inches, by 16 gives the result 7.81. In other words, if sixteen risers are used, each riser must be 7.81 inches, or practically, $7\frac{13}{16}$ inches in height. If it is decided, however, to use seventeen risers, 125 inches will be divided by 17, and the result will be 7.35 inches, or practically $7\frac{3}{8}$ inches.

The foregoing process may be stated in the form of a rule as follows:

Rule.—*Assume a convenient height for the riser, and divide the height of the story by this height. This will generally give a number and a fraction. Dividing the height of the story by the nearest whole number will give the exact height of the riser to be used.*

9. Indication of Stairs.—Stairs are indicated on plans by lines showing the location of the treads, as well as the newels and hand rail. As the stairs extend from floor to floor, the entire flight is not shown on any one plan. Instead, only a portion of each flight leading from any floor is shown on the plan of that floor. For example, in the blueprint of the First-Floor Plan, the flight of stairs *k* leading from the hall to the second floor is shown only in part. Beneath the upper portion of the flight, a toilet room is located.

Another case is shown in *l* and *m*, where one flight of stairs ascends directly above another flight. A portion of one flight *l* going down from the pantry is shown, and a portion of the flight *m* running up from the kitchen, is shown. These portions are separated on this plan by the broken line *n*. The remaining portions of these flights are shown on the basement and the second-floor plans. An outside stair to the basement is shown at *o*.

10. It is customary and advisable to show the location of the stairs on the elevations or sections whenever possible. This practice tends to insure proper headroom, as it gives an opportunity to check up the risers, treads, and story heights, as well as the openings that must be left to receive the stairs. The architect usually figures these dimensions out carefully whether he puts all the lines on the drawing or not. When

the section cannot be taken longitudinally through the stairs the outline of the treads and risers is sometimes shown in dotted lines on either the elevations or sections, as in the blueprints of the East Elevation and of the Longitudinal and Transverse Sections.

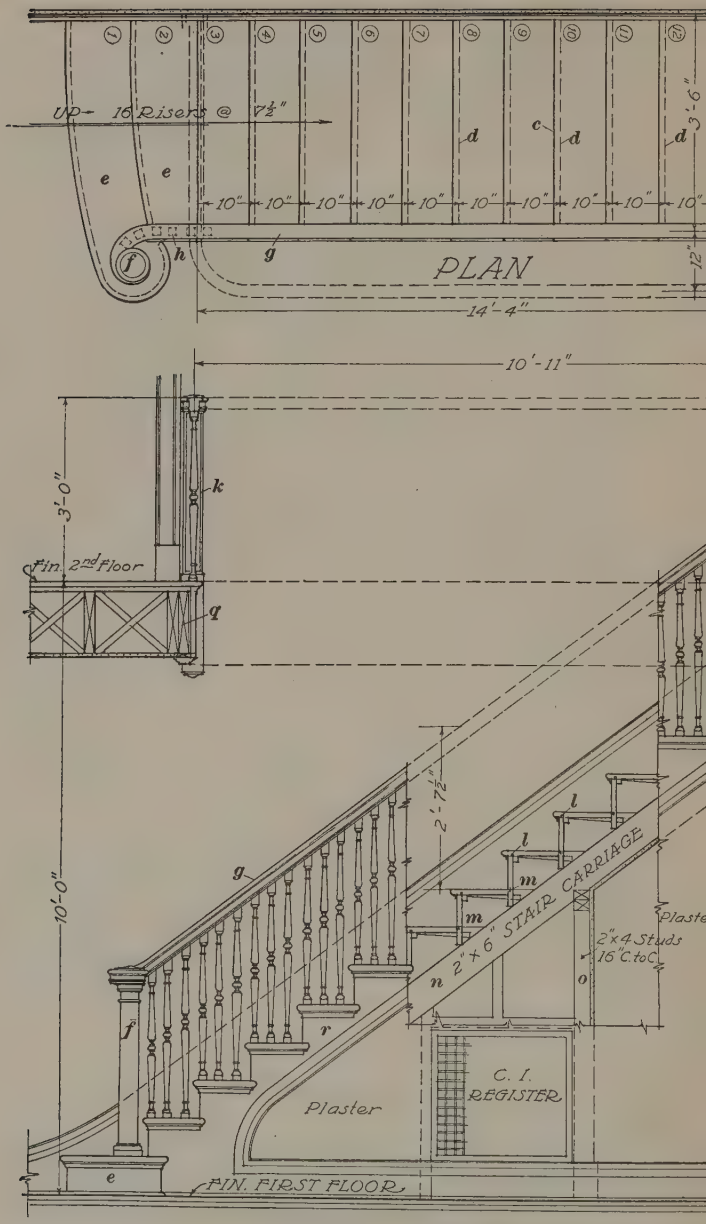
11. The architect designs the general arrangement of the stairs, and usually prepares a scale detail giving measurements which have been carefully worked out. An example of such a detail is given in Fig. 2, which shows the horizontal distance that must be allowed for framing the stairs to be 10 feet 8 inches for the actual open space, to which must be added 2 inches for the thickness of the fascia and the thickness of the top riser. An additional 1 inch is allowed for blocking or adjusting, making a total distance of 10 feet 11 inches. The height of the story from floor to floor is 10 feet, or 120 inches, which, with sixteen risers, makes the height of each riser $7\frac{1}{2}$ inches. The horizontal distance required for the treads is 15×10 inches $= 150$ inches, or 12 feet 6 inches.

For headroom, the header is placed above the nosing of the fourteenth tread, making a total distance down from the second floor of $14 \times 7\frac{1}{2}$ inches $= 105$ inches, or 8 feet 9 inches. From this will be taken the thickness of the floor construction, consisting of 12 inches for the joists, 2 inches for the double floor, and 1 inch for the plaster, making a total of 1 foot 3 inches. This distance, taken from 8 feet 9 inches, leaves 7 feet 6 inches for the headroom. As already explained, the headroom should be at least 7 feet, so this space is ample.

This drawing is a detail of the main stairs of the building shown in the blueprints and should be carefully studied in connection with the prints.

INDICATIONS OF PLUMBING WORK

12. Plumbers' Work.—The work of the plumber is shown on drawings by the location of the several fixtures which he is to install, together with the principal soil, waste, and vent pipes. These fixtures consist of bathtubs, shower

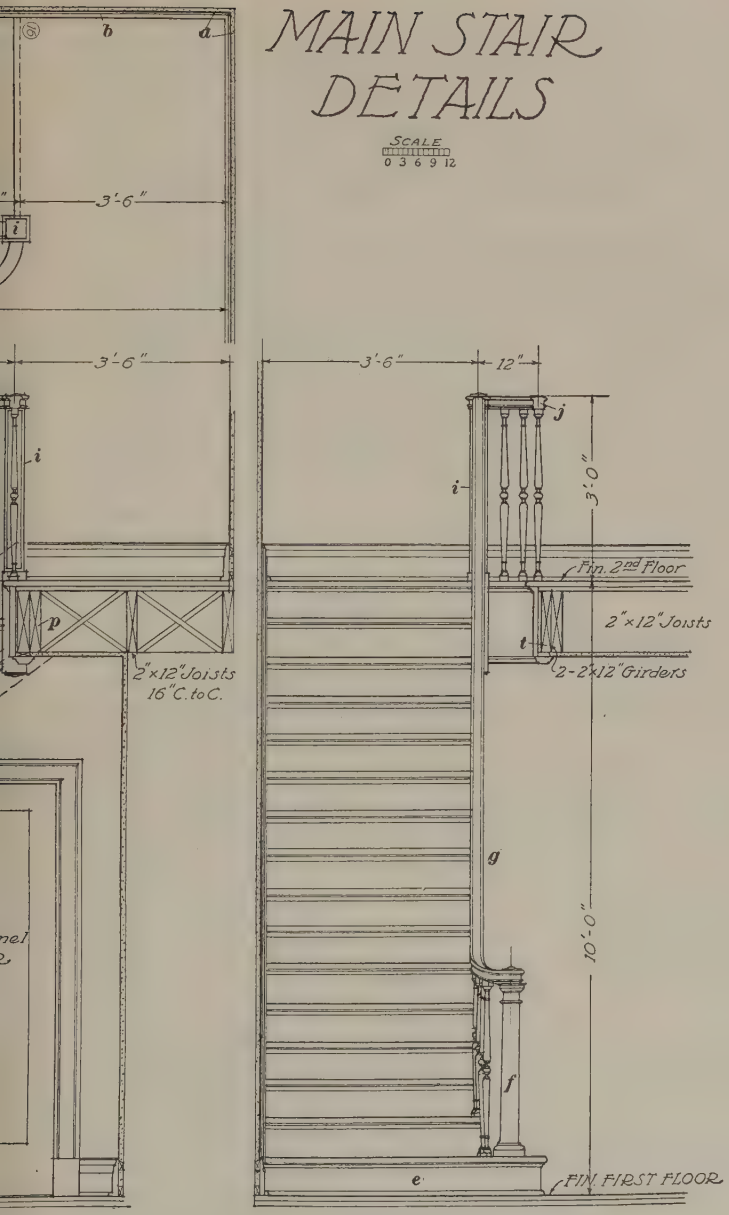


WEST ELEVATION

ILT 448 § 6

MAIN STAIR DETAILS

SCALE
0 3 6 9 12



NORTH ELEVATION

baths, wash basins, water closets, kitchen and pantry sinks, laundry trays or tubs, and refrigerator wastes. The fixtures are seldom located exactly on the plan by dimensions, but the architect should allow sufficient room for their installation and proper use. The sizes and designs of the various fixtures are found in the catalogs of the manufacturers.

13. Baths, or Bathtubs.—Indications of baths of various kinds are shown in Fig. 3 (*a*), (*b*), (*c*), (*d*), and (*e*).

Built-In Baths.—In (*a*) is shown a bath that is built into a corner tightly against both walls *a*, so that there will be no spaces to catch dirt between the bath and the walls. The rounded corners of the tub are shown at *b*, and the circle *c* represents a shower head, or shower, placed so as to send a spray of water over a bather standing in the tub. The double circle *d* represents a ring placed at the same height as the shower. To this ring is attached a rubber curtain which can be drawn so as to enclose the bather and prevent the water from splashing into the room.

Recessed Baths.—In (*b*) is shown an indication for a bath that is built against the wall on three sides, the front only being exposed. A shower appliance is indicated at the right-hand end of this bath.

Roll-Rim Baths.—In (*c*) is a free-standing roll-rim bath. Such a fixture stands on the floor on four cast-iron or porcelain feet, and is free from the wall all around. At *a* is the end where the water supply enters and the waste water runs out. The end *b* is semicircular in form and inclined inward to the line *c*. The thickness of the rim is the distance between the lines *d* and *e*. The rounded corners of the tub are shown at *f*.

Shower Baths.—In (*d*) is indicated a shower bath built in the form of a compartment, having sides formed of slabs of marble or glass, and a glass door in the front. The sides and the door prevent the water from splashing out of the compartment. A receptor, or tray, *a* is formed as a floor for this device, and is drained toward the center, where the water enters a trap below the floor.

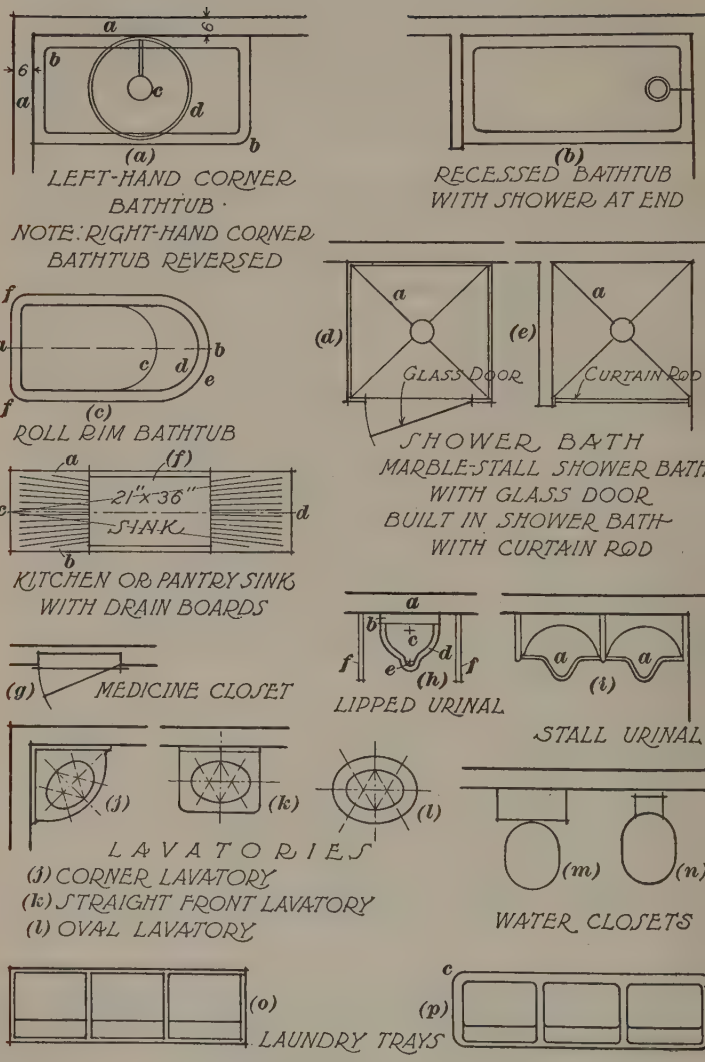

a
6
b
c
d
(a)
LEFT-HAND CORNER BATHTUB
NOTE: RIGHT-HAND CORNER BATHTUB REVERSED
(b)
RECESSED BATHTUB WITH SHOWER AT END
f
e
(c)
ROLL RIM BATHTUB
(d)
(e)
GLASS DOOR
CURTAIN ROD
SHOWER BATH
MARBLE-STALL SHOWER BATH WITH GLASS DOOR
BUILT IN SHOWER BATH WITH CURTAIN ROD
(f)
21"x36"
SINK
KITCHEN OR PANTRY SINK WITH DRAIN BOARDS
(g)
MEDICINE CLOSET
(h)
LIPPED URINAL
(i)
STALL URINAL
(j)
(k)
(l)
LAVATORIES
(j) CORNER LAVATORY
(k) STRAIGHT FRONT LAVATORY
(l) OVAL LAVATORY
(m)
(n)
WATER CLOSETS
(o)
(p)
LAUNDRY TRAYS

FIG. 3

A shower bath in a compartment or alcove is indicated in (*e*) and, instead of a door, a rubber curtain supported on a rod is provided for the opening.

14. Kitchen and Pantry Sinks.—In Fig. 3 (*f*) is indicated a typical sink such as is commonly used in kitchens and pantries. This sink is marked *21″×36″*, which are the horizontal dimensions. Drain boards are shown at each end of the sink, and grooves, as *a*, *b*, formed in these boards drain water off the boards into the sink. Sinks are indicated in the kitchen and pantry in the blueprint of the First-Floor Plan.

15. Medicine Closet.—The method of indicating a medicine closet that is built into a wall is shown in Fig. 3 (*g*). This indication shows the approximate size of the closet and the direction in which the door swings. The usual location of a medicine closet is in the bathroom above the wash basin. The doors of medicine closets are usually fitted with mirrors instead of wood panels. Medicine closets are seen in two of the bathrooms in the blueprint of the Second-Floor Plan.

16. Urinals.—Two styles of urinals are indicated in Fig. 3 (*h*) and (*i*). In (*h*) is shown a standard form of lipped urinal secured to the wall *a*. The waste or outlet of the urinal is at *b*, and the lip, from which the urinal is named, is at *e*. Slabs of slate or marble *f* are generally placed at the back and at each side of these urinals.

17. Stall Urinals.—In Fig. 3 (*i*) are indicated what are known as stall urinals. These are made of solid porcelain, and are often placed between partitions, as shown. The lip-shaped receptors are shown at *a*, and are in one piece with the urinal. Such urinals are not used in private homes, but are used in offices, manufacturing buildings, and in schools.

18. Wash Basins.—In Fig. 3 (*j*), (*k*), and (*l*) are shown indications of wash basins, or lavatories. The one in (*j*) is a corner basin having an oval-shaped bowl, and has backs, which are shown against the walls by the double line. The

basin in (*k*) is a plain basin placed against a wall. In (*l*) is a free-standing basin supported on a pedestal. Wash basins are indicated in the bathrooms in the blueprints of the Second-Floor Plan, and in the toilet rooms in the Basement and the First-Floor Plans.

19. Water Closets.—In Fig. 3 (*m*) and (*n*) are indications of two styles of water-closet fixtures. The drawing in (*m*) shows a closet with a low-down tank, that is, a tank placed just above the back of the closet. A closet with a high tank is indicated in (*n*). A low-tank closet is shown in the toilet room under the main stairs in the blueprint of the First-Floor Plan. Water closets are located also in the toilet room in the Basement Plan, and in the bathrooms in the Second-Floor Plan.

20. Laundry Trays.—In Fig. 3 (*o*) and (*p*) are indications of laundry trays, or tubs, and two groups of trays are shown. The indication (*o*) is for wooden, slate, or soapstone trays. For porcelain trays (*p*), the edges are made thicker, and the corners are rounded, as at *c*. A set of three trays is shown in the laundry in the blueprint of the Basement Plan.

21. All of the indications of plumbing fixtures just given merely show that a given fixture is required in a given position. There is no attempt made to give details of the fixture. The complete description is always given in the specifications, or else the number and make of the fixture are specified, and the corresponding specification is found in the manufacturer's catalog. Some architects make it a practice to give the plumbing fixtures a number on the drawing for more certain reference in the specifications.

22. Stacks.—The pipes that serve to carry the soil and waste materials from the various fixtures are generally indicated on the plans. These pipes should be so arranged that they will not cut through the framework of the building, and so that they will not be seen. For this reason, partitions to cover the pipes must be built sometimes with $2'' \times 6''$ studs. The vertical pipes in the building are referred to as *stacks*,

and are indicated by small circles in the plans, and generally are marked to show their sizes and purposes. Thus, in connection with the pantry in the blueprint of the First-Floor Plan, a circle representing a 4-inch soil pipe appears in the partition between the pantry and the stairs. In the kitchen the corner of the room is boxed off to take a soil pipe as shown. These stacks serve the kitchen fixtures and the laundry in the basement, as well as the fixtures of a bathroom on the second floor. The Second-Floor Plan shows these same stacks, but in this plan they are marked *Vent*, since no fixtures discharge into them above that floor, and therefore they act merely as vent pipes. Indications of stacks will be seen in connection with all groups of fixtures and all single fixtures.

23. Drains.—As a rule all the vent stacks go through the roof, and all soil and waste stacks go down to the cellar, and thence into a series of almost horizontal pipes called *drains* or *house drains*. These drains are sometimes indicated on the cellar plan of the building, and sometimes, especially where the sewage system of the building is somewhat complicated, on a special plumbing plan. A plumbing section is shown in Fig. 5 of Part 1, *Reading Architects' Blueprints*, and this should be carefully studied.

The drains, besides receiving the contents of the stacks, are often required to take the rain water from the rain conductors, or leaders, and also any water that might collect on the cellar or area floors.

24. Example of a Drainage System.—In Fig. 5 of Part 1, *Reading Architects' Blueprints*, a drainage system is indicated which drains all the stacks from the groups of plumbing fixtures shown. It also drains all leaders, as shown by the leaders numbered *1*, *2*, *3*, and *4*. All of these leaders extend up to the roof, although portions are omitted in this drawing to avoid confusion in the lines of the drawing. The drainage system collects all the soil and water and carries it to the house trap just before it leaves the building. This trap is usually contained in a manhole or brick box having a stone or iron cover. The manhole can thus be opened at any time

and the house trap examined. The house trap is always provided with a fresh-air inlet which admits fresh air to the inside of the trap. The small circles, shown in the areas and in the boiler room in the blueprint of the Basement Plan, indicate drains and traps in one fixture.

25. The rain conductors, or leaders, are taken care of from a point just above the grade line by the plumber, who provides a cast-iron pipe and a trap for each leader stack. An inspection of the blueprint of the South Elevation will show at the foot of each leader the hub of a length of cast-iron pipe.

On the blueprints of the Basement and the First-Floor Plans the rain conductors are marked *R. C.*, and their sizes are given. The rain conductors are sometimes marked *Cond.*, for *conductor*.

INDICATIONS OF SHEET-METAL WORK

26. Rain Conductors, or Leaders.—The portions of the leaders above the cast-iron pipes installed by the plumber are generally of sheet metal. The blueprint of the First-Floor Plan shows them to be rectangular in shape and $3'' \times 4''$ in size for the main roof, and $1\frac{3}{4}'' \times 2\frac{1}{4}''$ for the porches.

The blueprint elevations show the leaders on this building. At the top of the leader is a *leader head*, or *box*, shown at *q* in the South Elevation. When the cornice has considerable projection, as in this case, a *gooseneck p* is provided. This is a piece of pipe that is curved at the ends and connects the gutter with the leader head. The goosenecks can be seen in the East and the West Elevations.

27. Gutters.—The gutters that receive the rain water from the roof are shown in the blueprints of the elevations. The gutter is generally pitched, that is, the bottom of the gutter slopes down toward the goosenecks, although the top of the gutter is kept level for the sake of appearance.

28. Roofs.—Roofs that are to be covered with sheet metal are generally so marked on the drawings. The metal

to be used is sometimes mentioned on the drawings and should always be described in detail in the specifications.

29. Flashings and Counterflashings.—Flashings are used to cover the joints between different parts of the building where water would enter, were the joints not properly covered. The principal places where flashing is used is at the angles between roofs and walls or chimneys, as at *h* in the blueprint of the South Elevation.

30. Between the chimney *e* and the roof is shown a construction called a *cricket*, or *saddle*, the purpose of which is to divert the water from the back of the chimney. This construction is covered with metal which extends under the roofing and is turned up against the chimney, the turned-up edge being covered by counterflashing. In the West Elevation, the same construction is indicated behind the chimney by broken lines.

INDICATIONS OF HEATING EQUIPMENT

31. Types of Heating Apparatus.—The three commonly used types of heating apparatus are *hot air*, *hot water*, and *steam*. Heat is supplied for hot air by a furnace, and for hot water or steam by a boiler. An indication of a boiler is shown on the blueprint of the Basement Plan.

32. Registers.—In buildings that are heated by hot air, the air enters the rooms through registers generally made of cast iron. These registers are sometimes placed in the walls or partitions, and sometimes in the floor or ceiling. A wall register is indicated as in Fig. 4 (*a*), a ceiling register as in (*b*), and a floor register as in (*c*). In the blueprint of the First-Floor Plan, floor registers are shown at *p* in the dining room and at *q* in the living room. A register face is seen in the partition under the stairs in Fig. 2.

At *a* in Fig. 4 (*d*) is shown a section through a hot-air duct, such as is placed in a wall or partition, for carrying hot air from a furnace to a register located in one of the rooms of

the building. When provided with a wall outlet, the register appears as a heavy solid line, as at *b*. An arrow shown at *c* with a straight shaft indicates the direction in which the air flows.

When a ventilating system is provided, and air is to be removed from a room, the register face in a wall appears as in Fig. 4 (*e*), the outlined register indicating that the air passes out from the room into a conveying duct. A ceiling register or outlet is indicated as in (*f*), and a floor outlet as in (*g*). When an outlet duct in a wall is shown in plan, it appears as at *a* in (*h*), a register face being shown as a rectangle enclosed with light lines *b*, the arrow *c* with a wavy shaft indicating the flow of air from the room into the duct.

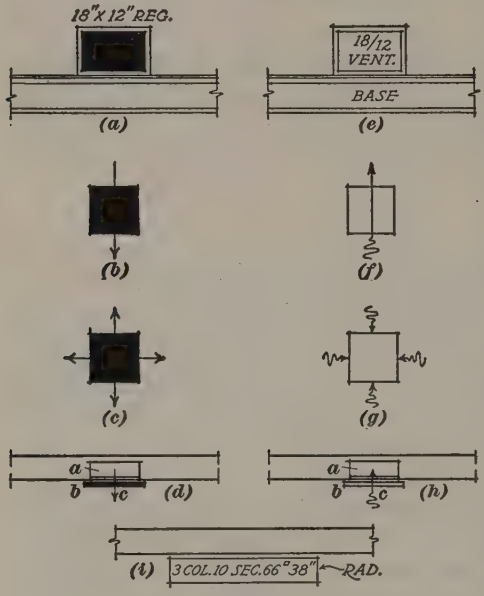


Fig. 4

The register faces through which the air passes are usually marked with the size of the face as in (*a*) and (*e*), the abbreviation *Reg.* for register being applied sometimes when a hot-air or fresh-air register is indicated, and *Vent.* being used for a ventilating flue or outlet.

Register faces placed in front of concealed radiators are shown the same as hot-air registers. Examples of these registers are seen in the blueprint of the First-Floor Plan at *r*, where there is a radiator concealed under the main stairs in the hall, and another radiator concealed under the seat in the living room, at *s*.

33. Radiators.—A hot-water or steam radiator is indicated on plans by a plain rectangle with the abbreviation *Rad.* as in Fig. 4 (*i*). The type and capacity of the radiator are indicated by the figures and marks in or near the rectangle By *3-col.* is meant a three-column radiator, there being three vertical passages through which the water or steam passes By *10-sec.* is meant that there are 10 sections to the radiator The *38″* shows the height of the radiator above the floor, and the *66*□ gives the number of square feet of radiating surface in the radiator. These marks are generally given to the architect by the heating contractor. They are often omitted from the architect's drawings and shown on a separate set of drawings that are prepared by the heating contractor.

34. Radiators are sometimes concealed and the heat from them enters the room through a register or grille. In the blueprint of the First-Floor Plan, at *s* in the living room, a radiator is concealed beneath the seat, which is marked *Seat, rad. under.* In such a case the register is fitted into the front of the seat. A radiator is also concealed under the stairs in the hall, as shown at *r*, from which the heated air enters the hall through a hinged register, as shown at *s* in the scale detail, Fig. 2.

35. Radiators are sometimes arranged so that fresh air is taken from the outside of the building and heated by the radiators before it enters the room. Such radiators are known as *indirect* radiators, and are generally concealed below the floor of the room to be heated. The air passes to the room through a duct and a floor or wall register. Thus, indirect radiators are placed under the living room and under the dining room shown in the blueprint of the First-Floor Plan, and the heated air enters through the floor registers *p* and *q*.

36. The piping used for hot-water and steam heating is seldom shown on the plans, as the exact location depends somewhat on the location of the studs, joists, and other framing. The sizes of the piping are seldom indicated on the

architect's plans, but this information appears in the specifications, or in the plans prepared by the heating contractors.

37. Kitchen Range.—In Fig. 5 is indicated an arrangement of a kitchen range and the smoke flue in connection with it. The rectangle, $2'\ 6'' \times 4'\ 6''$, represents the range itself, the larger rectangle representing the cement or brick hearth. Back of the range is a brick wall $8\frac{1}{4}$ inches thick, and at the right side of the range is a chimney flue *a*. This flue is shown surrounded by double lines which indicate terra-cotta flue lining. The space *b* between the flue lining and the brick flue is carried up to the top of the chimney and serves as a ventilating duct to take away odors from the kitchen. At *c* is a register set in the face of the flue through which hot air and odors pass into the ventilating flue *b*. Below this ventilating register is an opening through which passes the sheet-iron flue from the range to the smoke flue *a*, thus forming the draft connection for the fire in the range.

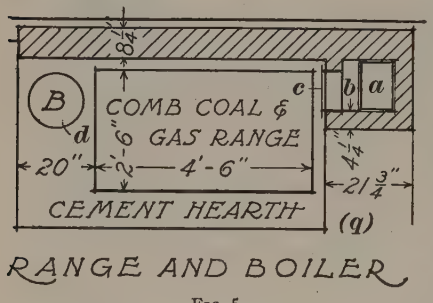


FIG. 5

38. At *d* is a circle representing a range boiler for hot water. The boiler is connected with the range and is shown standing on the hearth. A gas heater with a separate gas connection is sometimes connected to the boiler for the purpose of heating water independently of the range.

39. In the blueprint of the First-Floor Plan, at *t* in the kitchen a boiler is indicated in the manner shown in Fig. 5, and its capacity is 60 gallons.

Sometimes a boiler is supported from the ceiling in a horizontal position. In this manner floor space is saved, but in general the arrangement is not so satisfactory as when the boiler is vertical.

INDICATIONS OF GAS AND ELECTRICITY

40. Gas Heating and Lighting.—Gas is used for both fuel and for illuminating purposes. As a fuel it is usually connected to a combination range or to a gas range, and an outlet must be provided near the range, as in Fig. 6 (*a*). This outlet is marked *F.* or *F. G.*, to indicate that fuel gas is to be brought to that point. On a plan, fuel-gas outlets are indicated as in (*b*) when a wall outlet is to be provided, as in (*c*) when a ceiling outlet is to be provided, and as in (*d*) when a floor outlet is to be provided.

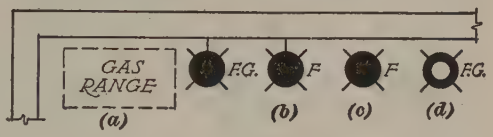


FIG. 6

41. Symbols for illuminating gas are similar to those for fuel gas, except that the letters *F.* or *F. G.* are omitted. A number is affixed to the symbol, indicating the number of gas tips on the fixture. Thus, in Fig. 7 (*a*) a two-tip wall outlet is represented, in (*b*) a three-tip ceiling outlet, and in (*c*) a four-tip floor outlet. These symbols on the plans indicate to the gas-fitter that he must install piping to supply the correct number of tips, but do not necessarily indicate that the fixtures are to be included in his contract.

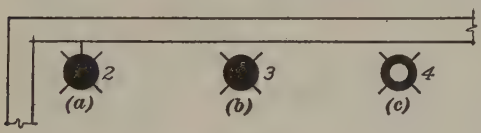


FIG. 7

42. Electricity.—In electric wiring, the indications show the location of the outlets to which the wiring must be brought, and the number of lights for which provision must be made. Thus, in Fig. 8 (*a*) a two-light wall outlet is indicated; in (*b*) a three-light ceiling outlet,

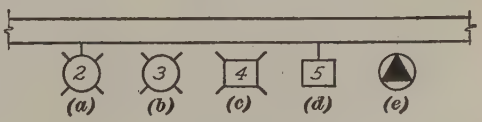


FIG. 8

or drop light, is indicated; in (*c*) a four-light floor outlet; in (*d*) a five-light baseboard outlet, and in (*e*) a special outlet for such purpose as may be designated. The wiring itself is not indicated on the architects' plans.

43. Combination Outlets.—In many cases a fixture is arranged for both gas and electricity. Thus, in Fig. 9 (*a*) is shown a wall outlet for three electric lights and two gas tips, while in (*b*) is shown a ceiling outlet for four electric lights and three gas tips. It will be noted that the number of electric lights is always placed above the number of gas tips. The letter *E* for electric lights and *G* for gas tips are sometimes omitted, but such an omission is apt to cause confusion.

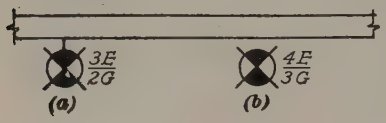


FIG. 9

44. Other Electrical Indications.—Switches to control the electric lighting are frequently shown on the architect's plans. One method of indicating switches is shown at *a* in Fig. 10, an *S* being shown for each switch. When the number of switches is large, a Roman numeral is sometimes used to indicate the number. Some architects draw lines from the switches to the lights which they control, as at *b*. A *panel board*, or *distributing panel*, from which the electric current is distributed to various points, is indicated at *c*.

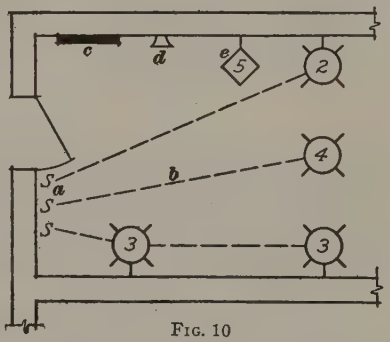


FIG. 10

An outlet for a telephone is indicated at *d*. This indication means usually that the contractor is to provide a conduit from the place where the telephone line enters the building to an outlet box at the point indicated. This permits the telephone company to install the instrument without boring holes or running exposed wires. Annunciators are indicated

as at *e*, the numeral indicating the number of points to which the annunciator is connected.

These indications are the ones commonly used by architects. Electrical contractors sometimes prepare more elaborate working plans, showing in greater detail the arrangement of their circuits and other equipment. These plans are submitted to the architect for approval.

PLANS OF A FRAME DWELLING

45. General Description.—In the foregoing Section and in the preceding pages of this Section, have been explained in detail the methods by which architects indicate on drawings the various forms of construction and the different materials used in buildings. In connection with these explanations, frequent reference has been made to the set of blueprints of a dwelling which accompany *Reading Architects' Blueprints*, Part 1. These blueprints will now be analyzed in order to make plain how the intentions of the architect have been indicated.

46. It is the aim of the architect to make his drawings so that they will convey definite ideas and be readily understood by men who are familiar with building materials and the methods of using them. Therefore, it is important that there shall be a definite reason for every symbol, line, letter, or figure placed on a drawing. No line or mark that does not have a special significance should appear on the drawings, as such lines or marks would confuse the contractor.

Repetition of indications or measurements on features that are identical in size and form need not, however, be made. For example, when belt courses, cornices, columns, etc., are ornamented by carvings, the ornamentation is often indicated over only part of the surface, and the fact that the entire surface is to be carved is indicated by the words *repeat ornament* or *continue carving*. In no case, however, should any room be left for doubt regarding the amount of work called for.

47. Architects differ in their methods of making drawings, and the reader in the course of his experience will see drawings that differ in some respects from those shown in the accompanying set of blueprints. These blueprints show, nevertheless, a complete representation of the building at a scale of one-quarter of an inch to the foot, and are standard, first-class drawings.

48. This set of blueprints consists of four floor plans, four elevations, and two sections. Each of these drawings is important and necessary, and shows features of design and construction that are not shown on the other drawings of the set. Taken together, they form what is called a "set of plans" or "the working drawings."

For the benefit of readers who may not have the blueprints at hand, a set of plates is inserted in this book. These plates are duplicates of the blueprints, except in the matter of scale, the blueprints being at a scale of $\frac{1}{4}' = 1'\ 0'$, while the plates are at the scale indicated on the drawings.

49. A set of blueprints, such as these, together with a set of specifications, is what the contractor receives from an architect when the contractor is asked to give an estimate of the cost of the building. It is therefore important that the contractor should thoroughly understand the drawings in order that he may figure the costs of the building intelligently.

50. Description of the Building.—The building shown on the blueprints is an eight-room residence, consisting of two stories, a basement, and an attic, or third floor. In addition to the living room, dining room, kitchen, and five bedrooms which make up the eight principal rooms, there are the various halls, stairs, closets, bathrooms, porches, etc., that are generally required in a house of this character.

The house is built upon a concrete foundation and the cellar or basement walls are of concrete. The upper walls are of wooden frame construction covered with lath and stucco, and the roof is covered with shingles.

FIRST-FLOOR PLAN

51. General Description.—A floor plan is a horizontal section through a building, and it shows the arrangement of parts on any one floor. A plan should be drawn for each floor of a building, as a rule. For the building shown in the blueprints, there are four plans, one each of the basement, first, second, and third, or attic, floors. The roof plan is combined with the third-floor plan, and the foundation plan with the basement plan. Of these plans the most important is the First-Floor Plan, as it shows the principal rooms of the house, those in which the family live and in which guests are entertained.

52. The rooms found on this plan are the living room, the dining room, and the kitchen. In addition to these, there is a hall, which communicates with the living room, the dining room, the rear porch, and the vestibule, as well as with the kitchen, the coat closet, and the toilet room beneath the main stairs. A large side porch extends along the left side of the living room. An enclosed porch is shown on the right of the dining room, and is designed to be used as a breakfast porch or room. Between the kitchen and the dining room is the pantry, from which the meals are served to the dining room and the breakfast porch. From this pantry, stairs lead to the basement. A service porch is provided at the rear of the building to give access to the kitchen. A large closet at the rear of the kitchen contains the refrigerator, into which ice is placed through the ice door in the service-porch wall. From the kitchen a flight of stairs, called the service stairs, or back stairs, leads to the second floor.

53. Entrance.—The first feature that is met by a person entering this building is the front steps. These are shown in the plan by four curved lines, three of which are stopped at the ends by rectangles projecting from the building. The steps themselves are made of brickwork, as is indicated by the numerous lines. The platform or floor is marked *Brick Floor*. The rectangles on each side of the floor are dotted indicating stone, concrete, or stucco.

54. In order to comprehend fully the meaning of this plan of the entrance steps, it is necessary to consult other drawings in this set. On the South Elevation is seen an elevation of these steps. The steps themselves are indicated as brick, and the rectangles on the plan are here shown to represent blocks of concrete on each side of the steps. These blocks are known as *cheeks*. The height of the risers and the height of the cheeks can be measured from this elevation.

The idea of these steps as given in the plan is very different from the idea shown in the elevation. Each idea is in itself incomplete, but the plan and the elevation taken together give a very satisfactory conception of the design of the steps.

The East Elevation shows a side view, or elevation, of the steps. The cheek is seen, and it hides most of the steps from sight. By the use of broken lines, however, they are indicated. The West Elevation gives a similar view of the other side of these steps.

The Basement Plan gives further information regarding the foundations of these steps. This foundation is designed to support the steps, platform, and the cheeks. The indications are those for concrete.

55. On the First-Floor Plan will be seen a section line *A*–*B* cutting through the plan. There must therefore be a section on the line *A*–*B*. This is found to be the Transverse Section. At the left-hand side of this section will be found a section through the steps. This section gives valuable information regarding the construction of these steps which appears on neither the elevation nor the plan. It shows a cut through the steps and platform, which are indicated as brickwork. It also shows that the steps are supported upon an inclined reinforced-concrete slab, the lower end of which rests upon a concrete wall, and the upper end on the wall *b*. The double line under the brick platform and steps indicates a space for the mortar bed in which the bricks are laid. The supporting wall *a* extends far enough into the ground below

the grade line so that it will not be moved by the action of frost. Around these walls are indications showing earth.

56. It will be seen that more than one drawing is required to indicate properly all the points that it is necessary to know before a feature such as the front steps can be constructed. In examining other features all the drawings that show parts of these features should be studied so as to obtain all possible knowledge regarding them.

57. The Vestibule.—The First-Floor Plan shows the vestibule projecting in front of the building. In the front wall of the vestibule is the main entrance door, which is a single door and marked *3′ 4″×7′ 0″*, which is the size of the door. The South Elevation shows this door in elevation. On each side of this door is a small window, which is called a *side light*. A corresponding window over the top of the door is known as a *transom*, or, if the window is stationary, as a *head light*. On each side of the front wall of the vestibule the plan shows two projecting rectangles with faint lines around them. On the South Elevation these rectangles prove to be pilasters, and the faint lines are the bases of the pilasters.

The East and the West Elevations show the side elevations of the projecting parts of the vestibule. The pilasters and side windows are shown corresponding to those on the plan.

In this plan, a stone sill is shown under the door opening. A tile floor extending over the entire vestibule is indicated by the squares and the notation *Tile Floor*. The indications, or squares, are shown over only a part of this floor, as is customary, but it is obviously unnecessary to show any more than is indicated in the plan.

The Transverse Section gives valuable information regarding the construction and the support of this part of the building. It shows that the front wall of the vestibule is supported on the wall *b*, and a corresponding wall is shown under the inner wall of the vestibule. These walls are indicated on the Basement Plan, the wall *b* in the section being marked *i* in the Basement Plan. This section further shows a concrete

slab resting on these two walls and supporting the tile floor. It also shows a paneled treatment of the walls, indicated at *j*, and a cornice at the top of the wall. A double beam is indicated which supports the portion of the front wall that extends across the ceiling of the vestibule. The construction of the roof and cornice of the vestibule is also indicated.

In the plan, a marble saddle is shown under the inner door of the vestibule. This door is called a vestibule door, and beside the dimensions on it appear the letters *Gl.*, indicating that a glass panel is to be placed in the door. The letters *Tr.* indicate that there is a transom over the door.

58. The foregoing articles illustrate the method of analyzing a portion of a plan. Such analysis includes the finding of parts of the other drawings that may present the part under consideration from other points of view, and thus obtaining all possible information. A careful study and comparison of the accompanying blueprint drawings in the manner just shown will result in the ability to handle a set of plans so as to get all there is out of them.

59. The entrance steps and the vestibule would not be erected from the blueprints of this set, but large-scale studies and drawings would be made, as well as full-size details of the caps, bases, moldings, etc., from which these features would be constructed. There is, nevertheless, sufficient information given in the prints to enable an experienced contractor to give an accurate estimate of the cost.

60. The Hall.—Between the hall and the dining room is a pair of sliding doors, indicated in the manner described in *Reading Architects' Blueprints*, Part 1. The indication of the sliding doors on the First-Floor Plan shows that the size of each door is 2′ 3″×7′ 0″. The section line *A*–*B* passes through this sliding door and turns at the middle of the dining room so as to be parallel with these doors. Consequently, on the Transverse Section on the line *A*–*B*, the opening for the sliding door will be seen in part, as at *k*. The actual doors are, however, not shown.

61. The finish of the dining room is also indicated at *l* in the Transverse Section. The doorway has a pilaster on each side of it and a cornice over it, forming a trim. This cornice extends all around the room. The walls are paneled and wainscoted. It is not stated on the drawing what material is used in this decoration, since decoration as elaborate as that shown is often done under a different contract from that for the main part of the building. If the decoration is to be included in the contract for erecting the building, the treatment of the dining room should be carefully described in the specifications. Detail drawings should also be made at a large scale, so as to show the intentions of the architect more clearly.

62. In the hall, opposite the sliding doors, as shown in the First-Floor Plan, is the entrance to the living room. This is not a doorway, but is an opening as indicated. A column is seen at each side in this opening. The heavy circle indicates the column, the larger circle shows the base molding, and the square represents the square part of the base. Back of each column is a pilaster, with a similar base. These also appear in elevation in the Transverse Section, and an ornamented cornice is shown above these columns and pilasters. This cornice extends around the hall, except over the stairs, and makes a rich and impressive effect. This feature must be carefully shown in detail drawings, from which it will be constructed.

63. Main Stairs.—The main stairs are shown at *k* in the First-Floor Plan. The subject of reading plans with reference to the stairs has been carefully discussed, and the indications shown on this plan should be familiar.

A toilet room is shown under the stairs, and this suggests the question of headroom beneath the stairs. By counting the number of risers it will be seen that the wall of this toilet room is under the tenth riser. These risers being $7\frac{1}{2}$ inches in height, the distance from the floor to the top of the tenth riser will be 75 inches, or 6 feet 3 inches. If from this a height of 18 inches is deducted for the construction of the stairs, it

will be found that the headroom at this wall is 57 inches, or 4 feet 9 inches, which is sufficient at this point in this toilet room.

The height of the door opening that can be obtained for this room can be calculated. Though all the risers are not shown on the plan, measurement will show that the edge of the door opening opposite the hinge is under the twelfth riser. Twelve risers at $7\frac{1}{2}$ inches each give a height of 7 feet 6 inches from the floor to the top of the riser. Allowance of 18 inches for the construction of the stairs leaves 6 feet clear headroom, which is sufficient. An elevation of the main stairs appears at *i* in the Longitudinal Section.

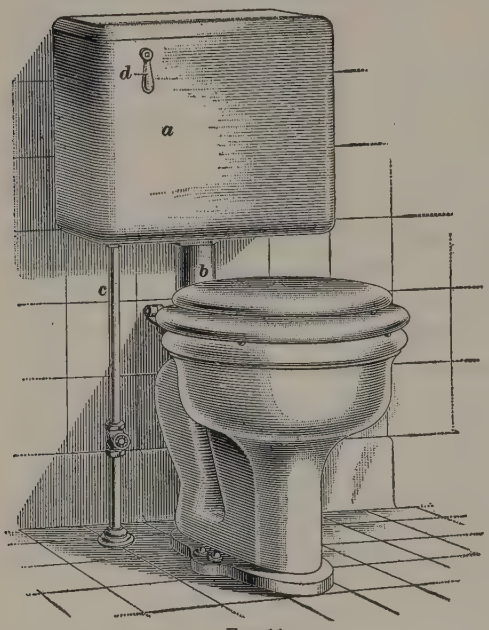


FIG. 11

64. In the toilet room beneath the main stairs, a corner wash basin is indicated. The window, which is also indicated should have a high sill so that it will be above the top of the wash basin. The water closet, on account of the limited headroom, is of the low-down tank type, as is indicated. This type of fixture is shown in Fig. 11, in which the tank is shown at *a*, the pipe for flushing at *b*, the water-supply pipe at *c*, and the lever for starting the flushing at *d*.

65. Closets.—Opening into the hall, as shown on this plan, is a closet for hats, coats, umbrellas, and other things. A shelf is shown by a line and also is marked. The letter *S*

on the jamb of the door indicates a switch that is operated by the closing or opening of the door. When the door is opened, the light is turned on in the closet. The walls of the closet are made thin by placing the studding flatwise in the partitions. This can be done where the partitions are not very long and are well braced, as they are around this closet. Flatwise studs occur in other parts of the building also.

An indication for a telephone is shown to the right of the coat-closet door. This position will permit placing a suitable table or stand to receive the apparatus.

A small closet, marked *Brooms*, is "worked in" back of the coat closet, making a very convenient place for receiving brooms, pails, carpet sweepers, and many of the utensils needed in house cleaning.

A closet is provided in the dining room for purposes connected with that room.

66. Rear Porch.—Back of the hall is shown a rear porch, which has a tile floor, as noted by the words *Tile Floor* and the squares which extend over a part of this floor. As has been pointed out, it is unnecessary to indicate tile over the entire surface. A flight of concrete, or cement, steps leads down from this porch to the garden level. The windows shown on the west side of this porch are sliding windows. On the east wall of this porch is a high window, shown by dotted lines.

67. Living Room.—The indications given in the living room will next be examined. The entrance opening from the hall has been discussed. The south wall is indicated as a frame wall, in which two double-hung windows are shown. The openings to the side porch are shown as French windows, which are indicated in the manner described in the previous Section. The French windows are shown on the West Elevation. Stone sills are shown both in the plan and the elevation. These windows will be built from scale and full-size details that will be furnished as the work of building progresses. The windows in the bay on the north side of the room are plain double-hung windows. These may also be

seen in the North Elevation. Book cases are indicated at *h* in the plan. They are indicated merely in outline and would be built from scale and full-size details. If they are to be included in the same contract as the rest of the house, the scale details should be made and given to the contractor with the rest of the blueprints, to be estimated on.

68. Fireplaces.—There are two fireplaces shown, one in the living room and one in the side porch. The body of the chimney is shown hatched in one direction and the brick facings of the fireplaces and chimney breast are shown hatched in the other direction. This latter hatching shows that the face of the chimney on the porch is treated with a special brick. The hearths within the fireplaces are shown with brick laid on edge with a simple pattern. This may be made of firebrick. The hearth in front of the living-room fireplace is of fancy tile, shown in squares and marked *Tile hearth*. At the backs of these fireplaces are shown small rectangles with diagonal lines. These indicate small cast-iron doors opening into ash chutes. The section line *C–D* shows that a section through these fireplaces has been made, and this will be found in the Longitudinal Section. The ash chutes are plainly shown on this section and lead down to a chamber, or ash-pit, formed in the base of the chimney. The Basement Plan shows this ash-pit with a clean-out door in front of it, through which the ashes are removed.

The double line around the outside of the tile hearth represents a strip of hard wood that is fitted tightly against the hearth, and nailed to the floor. The circles filled in solid indicate outlets for fuel gas. In the south end of this chimney is seen a flue with double lines around it. These lines indicate that the flue has a terra-cotta lining. The Basement Plan shows that this flue is for the steam boiler for heating the building, and that the boiler and the flue are connected by a galvanized-iron smoke pipe.

In the Second-Floor Plan the three flues are seen side by side in the chimney and built symmetrically with reference to the axis of the living room. All these flues are shown lined.

69. Various Features.—In the First-Floor Plan, a seat is shown built into the bay window at the north side of the living room. This seat is designed to cover a radiator, and is hinged so that it can be raised. Grilles are indicated in the front of the seat and are shown at *m* in the Longitudinal Section. By raising the seat the radiator can be reached and controlled.

70. In the front of the living room the First-Floor Plan shows a floor register at *q*.

There are two electric-light outlets in the ceiling, with the capacity of four lights each. Two side lights are indicated on the fireplace. The exact location of these lights will be determined by the design of the mantel. Four base outlets are provided so that floor lamps can be used at various parts of the room if desired.

The framing of the floor joists is indicated at various places by a line with arrows at the ends and the notation *2″×10″ Floor Joists 16″ c-c.*

71. Dining Room.—The dining room as it appears on the plan is a room almost square with all of its sides designed to be symmetrical. Thus the sliding door opening to the hall is centered on the left side of the room. The doors to the closet and to the pantry are placed at equal distances each side of the center of the room. The same is true of the doors and windows to the breakfast porch and the windows in the front wall.

The indications of floor registers at *p* and the light outlets are familiar and explain themselves.

The section lines *A–B* and *C–D* through the room call attention to the fact that parts of the room are shown on two sections. In the Transverse Section is seen the door trim of the sliding doors, and the wall paneling. In the Longitudinal Section is seen one complete side of the room, showing the doors to the closet and to the pantry, and the paneling of the wall in between, as well as an ornamented plaster or wood cornice around the room. A picture mold. or molding, is also indicated. The details of these features

of interior treatment will be constructed from drawings made at a larger scale and from full-size drawings.

72. Breakfast Porch.—The First-Floor Plan alone will tell the experienced architect a great deal about the breakfast porch, but an inspection of the South, East, and North Elevations will give an excellent idea of its external design, and will make clear the indications in the plan. The section of the porch shown on the Longitudinal Section will give further information. All these drawings having been examined, it will be seen that the outside of the walls are decorated with pilasters, and that sections through these pilasters are shown in the plan.

The windows are casement windows opening outwards, some being double casements and others single.

Double doors are indicated leading to the outside steps, which are dotted for concrete. These doors show on the North Elevation, and the steps are seen below them.

The tile floor and the baseboard outlets on the floor of the breakfast porch are indicated in the usual manner. Flower boxes are shown under two of the window groups.

73. Pantry.—A double-swinging door connects the dining room and the pantry. The essentials of the pantry are dressers, counter shelf, and sink. The sink is indicated on the north wall of the pantry. The dressers on the west and south walls consist of shelves enclosed by glazed doors for the upper part, a counter shelf extending under this, and enclosed drawers or cupboards beneath the counter shelf. The section line *A*–*B* extends through the pantry; therefore, on the Transverse Section an elevation of part of this dresser is shown as well as a cross-section. A cross-section of the sink is also shown. By carefully studying the plan and the section together, an excellent idea of the general design of this dresser may be obtained. In Fig. 12 is shown a large-scale detail of this pantry, in which the various parts have been drawn in larger size, and from which the contractor builds these dressers. This detail will be discussed more particularly later on, but it will be very instructive to compare it

diligently with the plan and section at the quarter-inch scale, as shown on the blueprint.

74. Kitchen.—In the First-Floor Plan another double-swinging door is shown leading from the pantry to the kitchen. A kitchen sink is indicated, close to which is shown a 4-inch soil pipe into which the sink wastes. An electric outlet is shown, by which the sink is lighted. Double-hung windows with a mullion *a'* provide an abundance of light for the kitchen and especially for the sink. A dresser is indicated, which will be like the dresser in the pantry in arrangement and construction.

A cement hearth is indicated, also a combination gas and coal range with a hood or canopy over it. The range may or may not be included in the contract.

75. A circle *t* containing the expression *60 gal.* indicates a hot-water boiler of 60 gallons capacity. A circle with radiating lines, marked *F*, indicates an outlet for fuel gas for the range.

A chimney is shown built of brick, and a brick wall extends behind the range as a means of fire protection. The chimney contains two lined flues and one unlined flue. The broken line that extends through the unlined flue represents the smoke pipe from the range to the lined flue marked *K*. The opening into the unlined flue from the range side is an opening that is above the stove pipe and under the hood. This opening exhausts the smoke and odors from cooking from under the hood, and is covered by a grille. A line marked *Reg.* indicates a similar vent opening from the kitchen into the same flue.

76. In the west wall of the kitchen, two high windows are indicated by the dotted lines. These will be seen in elevation at *i* in the Transverse Section. An annunciator with eight points is shown, also a door bell and a three-way switch. This switch turns on and off the electric light at the top of the service stairs from the kitchen, and a corresponding switch at the head of the stairs may be used for

operating the light from that position. Similar switches are indicated at each end of each flight of stairs.

77. Kitchen Closet.—In the closet off the kitchen, the shelves on the left side are indicated by lines and the word *shelves*. The number of shelves should be specified. The refrigerator is indicated on the right side of this closet, and it will be purchased from the manufacturer and set in place. The refrigerator will have to be selected before the exact location of the ice door can be determined and the ice door will be fitted in the wall to supply the refrigerator. Additional shelves or even a simple cupboard can be installed above the refrigerator if desired.

By means of a glass panel placed in the door to the kitchen, a certain amount of borrowed light will enter the kitchen at this point. This will add to the cheerfulness of the room.

78. Service Porch.—The service porch is placed so as to shelter the kitchen door. Five square posts are shown and railings between them. The design of the posts and railings can be seen on the North and the East Elevations, and a section through the porch appears on the Transverse Section. In this section, at *o*, the floor of this porch is shown lower than the floor of the kitchen. This floor is directly over a part of the laundry ceiling and is waterproofed so as to prevent water leaking through and spoiling the ceiling. This can be done by placing one or two layers of waterproof paper beneath the flooring, and sloping the floor away from the kitchen, so as to shed water rapidly.

The ceiling of the porch is under part of the floor of the room in the second story. This will cause this floor to be cold in cold weather unless it is insulated by some substance such as mineral wool, as shown in this section. In order to hold this mineral wool in place, a rough board floor is cut in between the joists and rests on cleats which are nailed to the sides of the joists.

The ice door *p* is shown in this section, but, as has been pointed out, will not be finally located until the dimensions of the refrigerator have been obtained.

79. A flight of steps leads from the service-porch floor to the ground level. A hand rail is shown on each side of the steps and is secured to the posts of the porch. These steps are shown on three of the elevations and in the Transverse Section. All of these drawings should be studied in conjunction with the plan to gain all the information possible.

80. Service Stairs.—The service stairs extend from the basement floor to the attic floor, or through three stories. The flight from the basement to the first floor ends at the pantry, as shown at *l* in the First-Floor Plan. The door at the top of this flight is a 2′ 6″×7′ 0″ door and is provided with a glass panel which will furnish light to the stairs. Another flight starts from the kitchen and is entered through a door having a glass panel. This flight, however, is well lighted from the window in the second-story hall. The electric outlets are placed at the tops of the flights in all stories so as to furnish light on the stairs at night time. A handrail is shown at the side of each flight.

81. The flights leading from the first floor to the basement and to the second floor are shown in elevation at *j* and *k* by broken lines in the Longitudinal Section. By drawing the stairs in elevation, the headroom between them can be seen and measured and errors avoided. Measured from the top of any riser in the lower flight to the top of the riser above it in the upper flight, the distance will be found to be 8 feet 6 inches. If an allowance of 18 inches is made for the construction of the upper flight, the remainder will be 7 feet, which is sufficient headroom.

At *l* in the Longitudinal Section is shown the elevation of the flight from the second floor to the third floor. On the East Elevation will be seen elevations of the service stairs extending from *a* to *f*.

82. The Side Porch.—The features on the side porch that are characteristic are the columns. The location of these columns is shown in general on the plans, but will be better understood by referring to the South, West, and North Ele-

vations, and to the Longitudinal Section. The West Elevation shows the effect that is desired in this porch. The cornice and the balustrade are of exactly the same design as those of the breakfast porch. It will be noted that the square parts of the column bases are made of cement or concrete.

A fireplace has been provided to be used when the porch is enclosed. It is intended that a set of removable glazed panels be placed between the columns in cold weather, and removed in summer. This porch will thus serve as a sun room in winter and as an open porch in summer.

The Longitudinal Section shows a cut through this porch, and the construction of the floor and steps can be seen. This concrete construction will be reinforced by some standard mesh, and all tied together with rods, especially at the junction of the floors and walls. The construction of the roof, cornice, etc., is also roughly indicated, and the actual construction will be in accordance with scale and full-size details.

83. Areas.—While areas are shown in connection with the basement windows, and consequently on the Basement Plan, they also appear in the First-Floor Plan, where the tops of the area walls are shown. Four of the areas appear in front of the south wall in this plan. An area under the pantry window is shown covered by a grating, to prevent a person descending the steps from the breakfast porch from accidentally falling into the area. Gratings are sometimes placed over all areas to prevent accidents.

An area containing steps to the basement is situated at the rear of the building, and, as shown in the First-Floor Plan, there is a pipe railing on the top of the outer wall to guard against accidents. The steps are made of concrete and surfaced with rich cement mortar. As shown on the Basement Plan, the walls of all the areas are made of concrete.

84. Section Lines.—Section lines *A–B* and *C–D*, shown on the floor plans, indicate that sections have been drawn on these lines. These sections have been drawn to

show what would appear to a person looking in the direction indicated by the arrows at the ends of the lines. Thus, on the section on the line *C–D*, called the Longitudinal Section, will be seen the building as it would appear if all the parts in front of the line *C–D* were removed. The use of such sections has been pointed out in the study of the First-Floor Plan. The section lines are taken through parts of the building that require further illustration, and need not be exactly over one another in the various plans.

85. Dimensions.—The subject of dimensions was discussed in *Reading Architects' Blueprints*, Part 1, and it will be a very useful exercise to study carefully the dimensions given on the blueprints. The various lines of dimensions in any one direction should be added to see if the totals agree.

86. Indications of Construction.—The indications of construction shown on the First-Floor Plan are those referring to the size, spacing, and direction of the joists. The Basement Plan shows girders that support the first-floor joists and the partitions on each side of the hall. On the Longitudinal Section these girders appear as three beams bolted or spiked together, with cleats on the sides of the girders to support the joists. The girders are supported on 5-inch pipe columns, which, as shown in the Basement Plan, are supported on concrete footings 2 feet square and 12 inches thick. In the Longitudinal Section, a section is shown through the header at the living-room hearth at *d*, and bridging between the floor joists is indicated at *e*.

87. A framing plan, which gives the arrangement of the joists and girders in the first floor, will be shown further on. The chimneys should be built from larger-scale details.

88. In the foregoing study of the First-Floor Plan it has been found necessary to refer to several of the other drawings in order to understand clearly the indications on the First-Floor Plan. This serves to illustrate the dependence

of one drawing on the other, and also the method of referring to the various prints to obtain information supplementary to that given on any one plan.

SECOND-FLOOR PLAN

89. General Description.—The indications on the Second-Floor Plan are in many respects similar to those shown on the First-Floor Plan. The indications for the outside walls, for the partitions, the double-hung windows, the doors, the lights, and the floor construction are just the same as for like features on the First-Floor Plan. Dimensions are also indicated in the same manner. The new features that are conspicuous in the Second-Floor Plan are the bathrooms.

90. Rooms on the Second Floor.—The second floor is generally devoted to the sleeping accommodations for the family and guests. The bedrooms are marked on this plan by numbers *1*, *2*, and *3*. A servant's bedroom is also shown on this floor and is marked *1*, this number indicating that there are one or more additional servant's bedrooms elsewhere on these plans.

There are two bathrooms for the family and one for the servants, and closets connected with all the bedrooms. A sleeping porch is also provided at the rear of the main hall.

91. Bedrooms.—The requirements for a bedroom are: Proper space for the bed, the bureau or dresser, and one or two chairs. There should be a suitable closet for clothing, and there should also be access to a bathroom, without the necessity of passing through another bedroom or living room.

92. Bedroom No. 1 is reached through a vestibule. Between the vestibule and the bedroom is an arched opening, as indicated by the broken lines at *d*. A small closet *e* is built in the corner of this room to make the bay-window effect on the north side, and so that the windows will be symmetrical with the bay. Another closet *f* with two shelves, is shown on the south side of this room. Two lighting out-

lets are indicated on the south wall. They are located so that a bureau can be placed between them. The best space for the bed is against the right wall. An electric outlet is placed conveniently for a table which can be placed at the head of the bed. Another base outlet is provided at the left side of the bay for a floor lamp that can be used for reading. Similar arrangements are shown in bedroom No. 2 and in bedroom No. 3. Bedroom No. 3 is the owner's room, and is provided with a private bathroom and two closets.

93. The servant's bedroom No. 1 has a closet in which a window is shown. While marked on the plan as a servant's room, it may be found convenient at times to use this room for members of the family or guests.

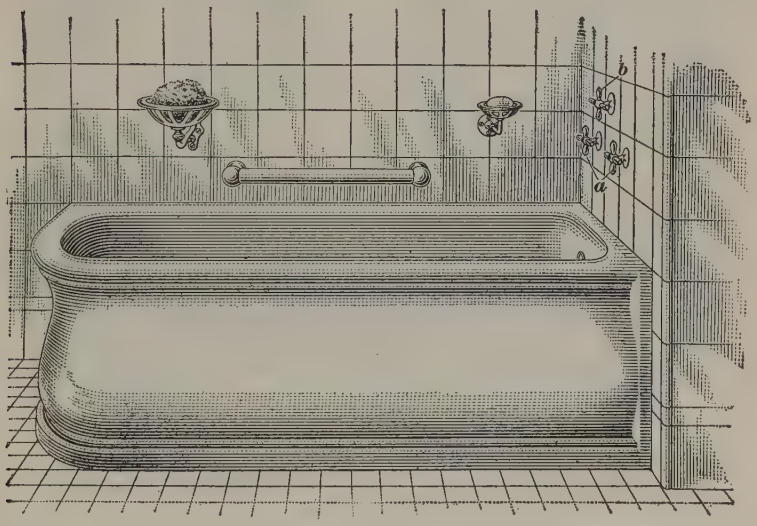


FIG. 13

94. Bathrooms.—The owner's bathroom contains a bathtub built against two walls. The small ring represents a spray, and the large circle the ring to hold the rubber curtain. A basin is shown with a medicine closet over it, and a water closet with a low-down tank is indicated. A bathtub installed in the manner indicated is shown in Fig. 13, and in

Fig. 14 are shown a shower, a basin, and a water closet of the kinds indicated on the plan.

The floor and wainscoting are to be of tile, as indicated by the notation on the floor. The closet opening from this bathroom will be convenient for linen and bathroom supplies. The door to this closet has a glass mirror in front of a wood

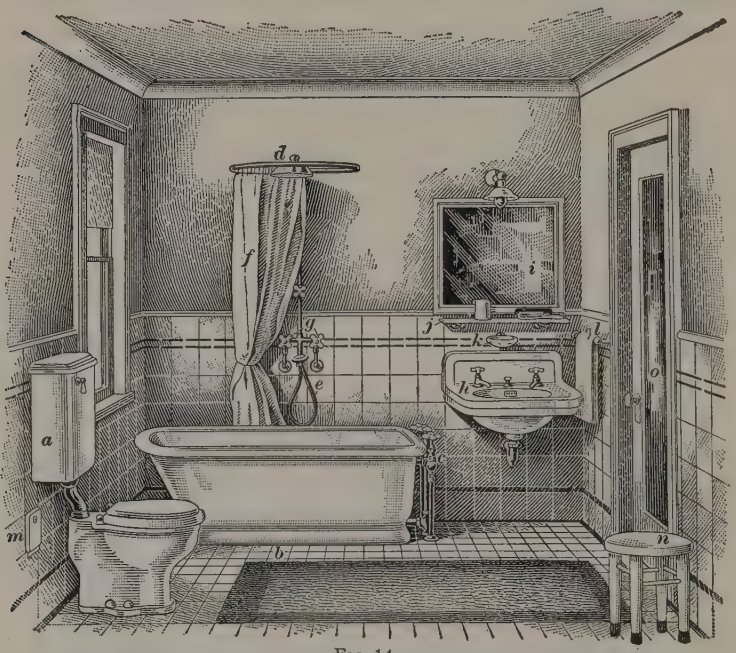


Fig. 14

panel. This is seen in the Transverse Section, which shows a section through the bathroom.

95. The bathroom opening on the hall is similar to the owner's bathroom, and a view of this is given in the Transverse Section. This view shows the basin over which is a medicine closet with a mirror in the door. A pipe, marked *4″ Vent*, is shown in connection with each of the bathrooms, and these pipes are placed as close to the water closet as the framing of the building will permit.

96. In the accompanying Fig. 14 is shown a general view of a typical bathroom in which a water closet with a low-down tank *a* is used. At *b* is a bathtub, with the supply and waste pipes at *c*. At *d* is the rubber ring that supports the rubber curtain *f*. Inside this ring is a shower that sprays the water over the bather standing in the tub. At *e* is a rubber tube with a spray on the end through which water can be sprayed. At *g* are mixing valves which regulate the amount of hot or cold water that is to be sent through the sprays. At *h* is a basin of the integral, or one-piece, type. At *i* is a mirror, and at *j* a glass shelf for holding toilet appliances. A soap dish is shown at *k*, and a towel rack at *l*. At *m* is a box to hold toilet paper, at *n* a stool, and at *o* a mirror set into the door. This arrangement represents a complete bathroom similar in most respects to those indicated in the building shown in the blueprints.

97. An interesting feature in connection with the construction of the tile floor is illustrated at *q* in the Transverse Section. In Fig. 15, which is a section through the floor con-

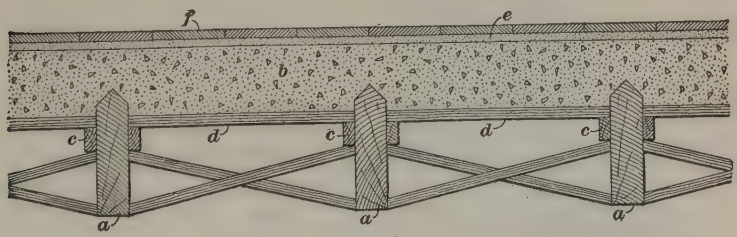


FIG. 15

struction, the joists *a* are shown cut down and pointed so as to separate the concrete *b* as little as possible. Cleats *c* are nailed to each side of the joists, and boards *d* are laid on the cleats. Upon the boards the concrete *b* is poured and on this is laid and leveled a bed of rich cement mortar *e* on which the tile *f* are laid.

98. In the servant's bathroom a water closet having a high tank is indicated. Such a fixture is illustrated in Fig. 16. In this figure the water-closet bowl is shown at *a*, the high

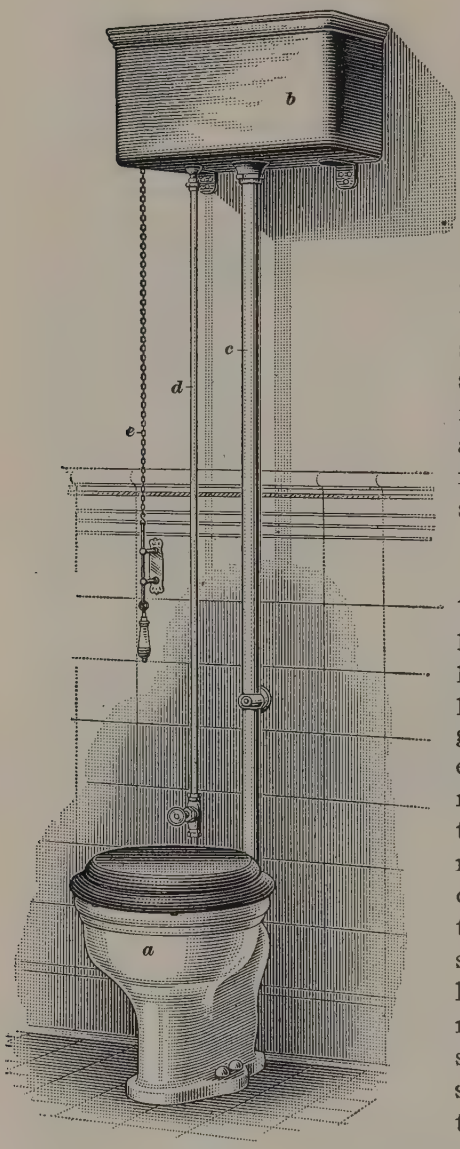


Fig. 16

tank at *b*, the flushing pipe at *c*, the water supply at *d*, and a chain pull at *e*.

99. Sleeping Porch. — The sleeping porch is enclosed on two sides by windows. The group of windows on the west side consists of sliding sash and the one on the north side consists of a casement window with fixed sash on either side.

100. The roofs of the front porch, side porch, and the breakfast porch are seen on this plan. These roofs show gutters around the outer edges and railings with newels inside the gutters. The slanting lines represent the changes in direction of the roofs, the roof areas all sloping so as to bring the eaves level all around. The roofs are covered with sheet metal, which should be carried up on the sides of the newels so as to make a rainproof joint.

BASEMENT PLAN

101. General Description.—The Basement Plan is very important, as it shows the part of the building that is built first. It should be very carefully marked with the dimensions. If these dimensions are not correct the building above will not fit the foundations and may have to be changed in the drawing and execution. This plan should have overall dimensions on it, such as 44′ 0″ for the front and 43′ 0″ for the side. These overall dimensions make it easy to lay out the building on the ground.

102. Walls and Partitions.—The walls shown in this plan have a very different appearance from those in the First-Floor Plan. They are more substantial, thicker, and marked with the indication for concrete. In general they are 12 inches in thickness. The broken lines 6 inches each side of the walls indicate the footings. These footings are shown clearly in the Transverse Section. Some of the walls that have lighter loads do not require footings if the soil has a good supporting value. Consequently the walls of the steps and porches have no footings indicated. The same is true of the walls of the areas. As a matter of economy, the walls of these parts are not carried down so deep as the main walls, as it is only necessary to carry them down below the point to which frost reaches.

Thus, on the South Elevation, the depths to which the different walls are carried are shown by broken lines. The foundation walls of the front steps *b* and the areas are carried down only to the depth of 3 feet 6 inches; this distance being below the level to which frost penetrates in most climates. The walls of the side porch and of the breakfast porch are carried down to the same level.

The walls of the main part of the building, however, are carried down so that the tops of the footings are from 4 feet to 6 feet below the finished top of the cellar floor, as at *a* in the South Elevation.

A careful study of the elevations in conjunction with the

Basement Plan is strongly recommended, and will result in a clear understanding of the plan.

103. In the Basement Plan a brick foundation wall is shown for the kitchen chimney. The brickwork of this chimney will show in the laundry, although this brickwork may be plastered if desired. A footing is shown by broken lines under this chimney and will be formed of concrete.

Concrete footings are indicated under the 5-inch pipe columns that support the girders upon which the first-floor joists rest.

104. Partitions.—The partitions shown in the basement, around the drying room, laundry, hall, and closets, are 4 inches in thickness, and are built with the studs set flatwise, and may be covered with plaster or wood on each side. The partition on the west side of the vegetable cellar is of studding with boarding on the left-hand side. The partitions around and separating the coal cellars are also of studding boarded on one side.

The coal bins are fitted with doors that are shown on the Longitudinal Section to be batten doors. The doors in the plastered partitions are paneled doors.

105. Floors.—The floors of the basement, with the exception of the laundry, hall, and closet floors, are of cement finish on a concrete base. The floors of the laundry and hall are of wood which is secured to beveled sleepers as shown in the Transverse Section.

106. Laundry.—A laundry stove is indicated with the stove pipe running into the flue. This flue is shown lined. The space *e*, which forms the flues above the basement, is left hollow to save brickwork. The stove would not be furnished by the contractor, however, unless so stated in the contract or specifications.

A set of three laundry tubs, or trays, is shown upon an elevated slat floor. These tubs will be similar to the set of tubs shown in Fig. 17.

A sink is indicated by dotted lines, and into this is drained the water from the melting ice in the refrigerator.

A fuel-gas outlet is shown on the north wall, which is to supply a gas iron or a stove to heat irons. A second fuel-gas outlet is shown near the chimney to supply a gas stove or iron heater, or possibly a hot-water heater.

A cast-iron clean-out door is indicated in the chimney at the bottom of the laundry flue, by the letters *C. O. Door.* By opening this door, the flue can be reached for cleaning when necessary.

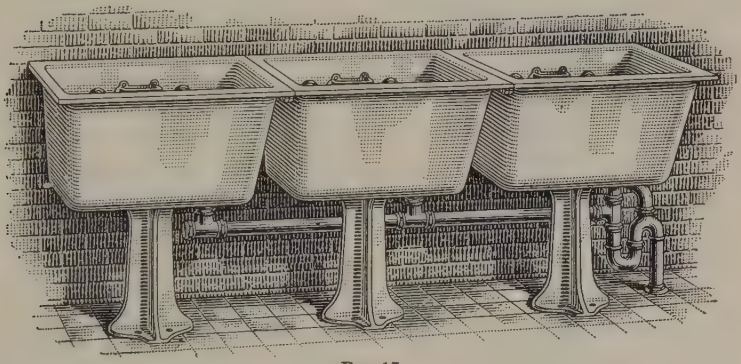


FIG. 17

107. A toilet for the use of the servants is provided in the basement, and contains a low-down tank water closet, such as shown in Fig. 11, and a corner wash bowl.

108. Area steps are shown leading from the grade to the basement. These steps are formed of cement-finished concrete. In the middle of the slab in front of the entrance door is a drain which is designed to carry away any water that might otherwise collect at the bottom of the steps. A door sill and step prevent water from washing in on the basement floor in case this drain should overflow. A drain is shown in front of the boiler and is intended to take away any water that might otherwise gather on the cellar floor.

109. Drying Room.—The drying room is a convenient place in which to dry clothes in damp or rainy weather. This

room is shown in the Longitudinal and the Transverse Sections and is finished with plain walls.

110. Vegetable Cellar.—The vegetable cellar is a place to store vegetables, preserves, canned goods, and other foodstuffs. The dark closet connected with it can also be used for preserves that might be injured by the action of light. The fronts of the preserve closets or shelves are shown in the Longitudinal Section. Wire-mesh doors are shown which can be locked. The dark closet can also be locked if desired. The drying room, vegetable cellar, and the dark closet are provided with electric-light outlets.

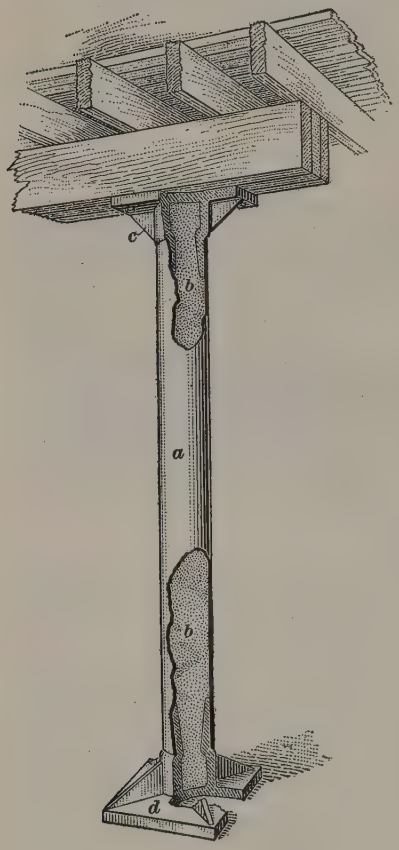


FIG. 18

111. Pipe Columns. The pipe columns are iron or steel pipes provided with suitable caps and bases. The pipes are sometimes filled with concrete, which makes the columns stronger than they would be if not filled.

A standard concrete-filled pipe column is shown in Fig. 18. It consists of a steel shell *a* filled with concrete *b*. A cap *c* and a base *d* of cast iron are fitted to the shell and are designed to support the load on the top and to spread the load on the footing. A 5-inch concrete-filled column such as is shown will support about 20 tons weight.

112. Boiler.—A boiler for heating the house is shown and marked. A pipe connecting it with the chimney is also indicated. This boiler would in most cases be supplied by the general contractor, although sometimes provided by a separate contractor.

Two coal bins are indicated, one for boiler coal and one for coal for the kitchen range, the laundry stove, etc. Openings to the coal bins are also shown, and in the Longitudinal Section is shown a batten door at *n* for one of these openings. The space marked *Boiler Room* is convenient for the storage of fire wood, also as space for ash cans, etc.

THIRD-FLOOR PLAN

113. General Description.—The plan of the third floor differs very much in appearance from the plans of the other floors. The fact that there is only one room in this entire floor would suggest that space has been wasted. An inspection of the Transverse Section, however, will show that the roof is so close to the floor that there would not be sufficient height for a man to stand over a great part of the floor. Most of the space is therefore of little use except for trunk space, closets, etc.

The requirements of the owner call for only one bedroom on this floor, and this is the servant's bedroom No. 2. In addition to this room, there is space for a trunk room and for a cedar closet, the latter being lined with cedar wood, as a protection against moths, for the preservation and storage of furs, blankets, and spare clothing. There is space enough under the middle part of the roof for the accommodations shown on the plan.

114. Another peculiarity of this plan is that a plan of the roof has been combined with it. The eaves, hips, valleys, and ridges are shown. The parts of the roof below the plane at which the plan is shown are drawn in solid lines. The parts of the roof that are above this plane are in broken lines. As the plan is shown at a plane about 4 feet above the floor,

the roof below this plane would naturally appear on the plan. The parts of the roof that are shown by the broken lines would not appear, however, and they are therefore drawn in broken lines, which indicate the construction above. It would not be economical to show the roof on a special plan for the sake of showing these few broken lines, consequently they are included in this plan.

115. Eaves and Gutters.—This plan may be considered first as a roof plan. The three lines shown all around the outer edge of the plan show the gutter into which the roof drains. At certain points goosenecks *a* are shown by broken lines leading to the rain conductors. The bottom of the gutter is sloped downwards toward these goosenecks. The highest points in the gutter are marked *High Point*, and the arrows in the gutters show the direction in which the water flows. The diagonal lines at the projecting corners indicate the hip rafters *b*, which meet at the ridge *c*. A ridge terminating in the north gable is shown at *d*. The diagonal lines *e* indicate valleys.

The broken line marked *Face of Wall Below* represents the outer face of the wall of the second story. The outside face of the studs is $2\frac{1}{2}$ inches inside this line, and the dimensions on the plan are taken from the stud line, in the same manner as in the first- and second-floor plans.

116. Flat Roof, or Deck.—A flat roof, or deck, is shown to the north of the bedroom. The sloping lines on this roof represent valleys caused by changes in the slope of the roof. These valleys guide the water to the *sump*, which is a shallow box, seen in the North Elevation. From the sump the water runs out through a hole in the parapet, called a *scupper*, onto the roof and thence into the gutter. A parapet wall extends around two sides of the deck and is covered with sheet metal. The tops of these parapets merge into the sloping roof. These parapets are visible in the North and West Elevations.

117. Another flat deck occurs over the servant's bedroom No. 2 and is indicated by the rectangle *f g* and the

diagonals shown in broken lines over the bedroom. Neither this deck, nor the one just described, are visible from the ground. As they are practically flat they must be covered by tight roofs, and properly drained by means of leaders, as shown on this drawing.

118. Roofs of Dormer Windows.—The roofs of the dormer windows are shown in dotted lines entirely, as the plan is taken on a plane passing through the windows below the roof. The projection of the roof of the north gable is shown by dotted line *h*.

119. Walls and Partitions.—The outside walls of the bedroom on the north side are stud walls covered with plaster, or stucco, similar to the main walls of the building. In this wall are indicated three double-hung windows.

Around the dormer windows also are exterior walls, the front walls being occupied by windows, and the side walls covered with shingles. This treatment will be seen in the Transverse Section. Between the dormers, at *i* in this plan, a single line is shown which represents a wall that is plastered on the inside only. Similar lines are shown enclosing the cedar room, the closet of the bedroom, and the trunk room. All these lines indicate the plaster face of partitions that are plastered on one side only. An examination of the sections will show the details of these partitions.

120. Thin partitions are indicated around three sides of the bedroom, and on one side of the trunk room and cedar room. These partitions are formed by placing the studding flatwise and plastering on both sides.

The walls at the backs of the cedar room, closet, and trunk room, as at *j* and *k*, are only about 4 feet 6 inches high, as will be seen in the sections. This is a sufficient height for the purposes for which these spaces are used. The full ceiling height extends over about one-half of these areas, so that there is sufficient headroom to permit people to enter them.

121. Stairs.—The service stairs reach the third floor, as shown, by fourteen risers. These stairs are lighted by

direct light from the front dormer window. At night time a light at the head of the stairs is useful and can be operated by a three-way switch. By the use of this switch the light can be turned on at the second floor and turned off after the servant has reached the third floor, and vice versa.

A hand rail is shown by the double line at the right side of the stairs.

122. Dimensions.—It is not necessary to show many dimensions in this plan. The dormers are located so as to be symmetrical with the main axis of the south elevation. The distance of the face of the dormer from the front wall is also marked.

The rear wall of the bedroom is located with reference to the main walls of the second story, and the bay should be placed at the central transverse axis of the building, so as to be symmetrical with respect to the ridge, as seen in the north elevation.

The walls, or partitions, enclosing the stairs are built so that the faces against the stairs are the same as those in the partitions below in the second story.

The partitions on one side, as at *j* and *k*, can be located with sufficient accuracy by scaling off or measuring with a rule.

The chimneys will be carried up directly over the chimneys shown in the Second-Floor Plan.

SOUTH ELEVATION

123. Elevations.—The purpose of the elevations is to show the sizes, arrangement, and relation to each other of the features of the exterior of the building. Elevations show the doors, windows, walls, roofs, porches, and chimneys, also the levels of the floors, and the finished level of the ground at the building; they also give the heights of the various stories, sizes of window openings, etc.

124. Walls.—The walls of the building are shown as plain surfaces marked with dots over part of the surface.

This indicates a stucco finish, which should also be described in the specifications. A similar stucco finish is indicated on the chimneys.

In the south elevation, a water-table *m* is shown extending across the elevation, and is dotted to indicate that it is stuccoed. Certain portions of this water-table, as at the side porch and the breakfast porch, are of solid concrete. The indications for stucco and concrete are similar. The wall below this water-table is similar in appearance to the wall above, but in this case it is a concrete wall below the water-table, as indicated by the notation on the wall. In a case like this, the specifications should be consulted to ascertain the character of the walls of the house. The plans should also be examined, and it will be seen that the Basement Plan shows a concrete wall, and the First- and the Second-Floor Plans indicate a frame wall. A frame wall in the plan, dotted in the elevation, shows clearly that this wall is stuccoed. The specifications will verify this conclusion.

In the elevations the walls below the grade line are indicated by broken lines. The walls supporting the porches, and the area walls, are started below the frost line, or about 3 feet 6 inches below the finished grade, and the walls of the building itself are carried down below the basement floor and are supported on footings lettered *a* in the South Elevation. These footings extend 6 inches each side of the wall and are 12 inches in thickness.

125. Windows.—The windows in the first story are typical double-hung windows with shutters. The sash opening is marked *S. O.* on one of the windows, and the other windows are marked *Do.*, or ditto, to indicate that the same notation applies to them all. The horizontal dimension of the sash opening is shown as *3′ 6″* and the vertical dimension *5′ 9″*. The upper sash is shown divided into six lights, while the lower sash is in one light. The shutters are made with solid panels, a small crescent-shaped opening being made in the upper part of each.

The windows in the second story are also double-hung, and

have blinds with movable slats instead of shutters. The window over the entrance porch is not so high as the others as it is in a bath room. The size of the sash opening is given for these windows in the same manner as for those in the first story.

The windows in the dormers are double-hung windows, and the size of the sash opening is given. The basement windows are single-sash windows. The parts of the building above the ground level, or grade, are shown by solid lines and the parts below are in broken lines.

A double-casement window *n* is shown in elevation. The First-Floor Plan shows that this window opens outwards, and that the windows on each side also swing outwards.

126. Porches.—The entrance porch, as was noted in the discussion of the plans, is decorated with pilasters, cornice, and railings. The breakfast porch is treated in the same manner, while the side porch differs only in having columns instead of pilasters. These decorative features are generally shown at a larger size in scale details and in full-size details, from which they are constructed.

The entrance porch contains the entrance door *l*, which is surrounded on three sides with sash forming side lights and head lights, or transoms. This feature is also built from scale details and full-size details.

127. Roof.—The roof *g* is marked *Shingle Roof* and the horizontal lines indicate shingles. The hips are finished in what is known as "Boston hip" fashion. The hips of the dormers are finished similarly. A slate roof would be indicated in the same manner as a shingle roof, but would be marked *Slate Roof*. At the eaves are shown the gutter *o*, and two rain conductors marked *3″×4″ R. C.* The water runs from the gutter through goosenecks *p* into the conductor head *q*. The conductor is held to the building by means of straps *r*. A view of a gooseneck and a conductor is given in Fig. 19. Smaller rain conductors are shown on each side of the entrance porch, and these lead off the water from the roof of that porch.

128. Chimneys.—The chimneys are shown as they come up through the roof from the second floor. At the place where they meet the roof sheet metal is indicated by vertical lines. This metal, called *flashing*, is built into the joints of the brickwork, which accounts for its appearance of being in steps, or *stepped-up*. Behind the chimney *e*, at *h*,

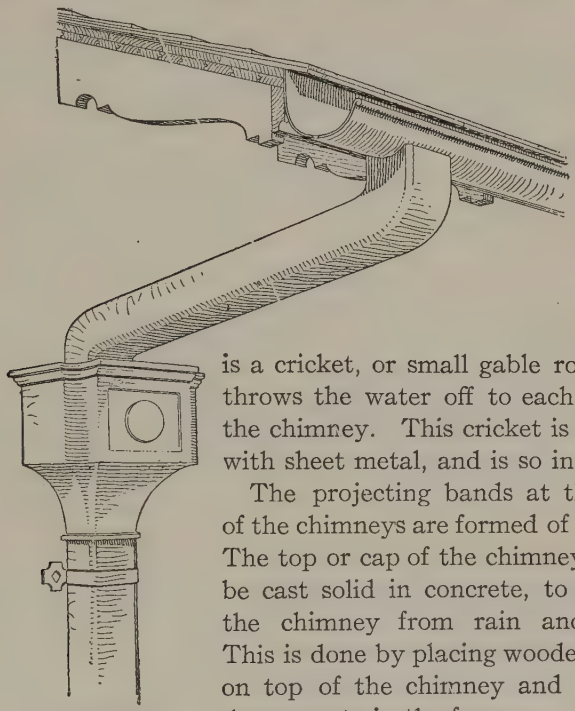


Fig. 19

is a cricket, or small gable roof, that throws the water off to each side of the chimney. This cricket is covered with sheet metal, and is so indicated.

The projecting bands at the tops of the chimneys are formed of cement. The top or cap of the chimney should be cast solid in concrete, to protect the chimney from rain and frost. This is done by placing wooden forms on top of the chimney and pouring the concrete in the forms.

129. Dimensions.—The principal dimensions shown on elevations are the story heights, as shown at the left-hand side of the South Elevation. The levels of all the floors are shown by a dot and dash line, and the distances between them are marked.

The next important dimensions are the heights of the window sills, above the floors. These are given in the line of dimensions through the left-hand windows. The distances of

the sash openings above the floors, the heights of window openings and the distances between the tops of the window openings and the floor above are marked. The height of the ceiling of the attic is also shown and its distance above the third-floor line is given.

WEST ELEVATION

130. Principal Features.—From the explanations that have already been given of the South Elevation and the other drawings, the indications on the West Elevation will be easily understood.

The main feature of the West Elevation is the elevation of the living-room wing. As was noted while considering the First-Floor Plan, this elevation of this wing is symmetrical with reference to an axis line through the middle of the chimney, or through the living room.

The walls are shown as in the South Elevation, also the stucco finish of the chimneys. The foundations of all the porches and steps are shown at the proper depths. The footings of the main walls of the building are properly shown. The steps are shown in broken lines, as they are back of the cheeks.

131. Chimney.—An elevation of the fireplace in the side porch is given, and the indications show that the fireplace will be faced with some fancy or ornamental brickwork. The flues, which are shown by means of broken lines, are brought over so as to be symmetrical with the axis of the wing to permit the chimney itself to be made symmetrical.

132. Windows.—The windows of the living room are French windows, that give access from the living room to the side porch. The windows over them in the second floor are typical double-hung windows, and the sash openings are properly marked.

Sliding windows *a* and *b* are shown on the rear porch and on the sleeping porch above, while single, hinged sash appear in the wall of the basement.

133. Roof.—The roof is shown as a shingle roof with Boston hips. The gutter and the brackets under the eaves are indicated. In this elevation the goosenecks are shown extending from the conductor to the gutter, in graceful curves.

The parapet around the flat roof above the sleeping porch is also shown and the roof behind the parapet is indicated by a broken line. A cricket, seen at *h* in the South Elevation, is shown behind the chimney in this elevation by broken lines. The object of this cricket is to throw the water to each side of the chimney, and to prevent the formation of a pocket that would collect rain and snow.

In the West Elevation, the dormers are shown in side elevation, and are shingled on the sides in the same manner as the roof.

The roof of the side porch is what is called a flat roof, although it has a slight pitch; it is covered with sheet metal, probably tin, which is painted to protect it from the weather. The roof over the sleeping porch is also flat and likewise covered with tin. The roof *c* over the bedroom on the third floor is treated in the same manner.

The roof of the side porch is drained by a gutter which leads to the conductors shown on each side of the living-room wing.

134. Dimensions.—The necessary dimensions showing the story heights and the locations of the windows with reference to the floors are given at the left side of this elevation.

EAST ELEVATION

135. General Features.—The East Elevation presents very little that has not already been discussed in the study of the South and the West Elevations. The walls, foundations, chimneys, and windows, are indicated in the same manner as those already described. A mullion window is shown in the kitchen. This mullion window consists of two double-hung windows having a common weight box between them.

The sills of the kitchen windows are kept higher than usual in order to be above the drain board of the sink; and the pantry windows are, for the sake of appearance, kept at the same height. Single-sash casements are shown in the basement under the kitchen window, while a double-hung window is shown under the pantry window. This window is in the drying room.

Side views of the front steps and of the steps from the breakfast room are shown.

136. Service Porch.—The square posts supporting the building over the service porch are clearly shown in this elevation, together with the rails and balusters between them. A lattice is shown which screens the porch from view, and may be used to support a vine. A flight of steps is shown with rails, balusters, and newels, also a lattice of slats beneath. A pier supporting these steps is shown in dotted lines and will be seen in plan at *f* in the Basement Plan.

137. Stairs.—An indication of the service stairs is shown in the East Elevation, where the entire series from basement to attic is shown, starting at *a* and ending at *f*.

138. Breakfast Porch.—On the front and side of the breakfast porch flower boxes are indicated under the windows. These boxes are shown supported on brackets. All this work will be executed from scale and full-size drawings that will be prepared by the architect later on.

On the sheet with the East Elevation is shown a section taken through the front, or south, wall of the building. This section is shown for the purpose of giving a general idea of the construction, as well as to show the relation of the floor levels to the window openings. This relation is shown by the vertical line of dimensions at the left of the section.

The construction of the sill, the plate, the cornice, and the dormer window is given with sufficient clearness to permit of estimates being made. The actual construction will follow large-scale and full-size details, which will be furnished by the architect as required.

NORTH ELEVATION

139. General Features.—The North Elevation, which is the rear elevation, while it may be considered of the least importance, is in some respects the most interesting of all. It has a greater variety of indications than any of the other elevations: The walls and chimneys are indicated in the same manner as on the other elevations. The side porch is shown in the same manner as on the South Elevation. The breakfast porch shows the entrance doors and steps. The service porch shows the elevation of the steps. The rear porch also shows the steps in elevation. At the right the cheek slopes parallel to the steps, while on the left the cheek is brought out square, to receive the pipe railing which serves as a guard against persons falling into the basement area.

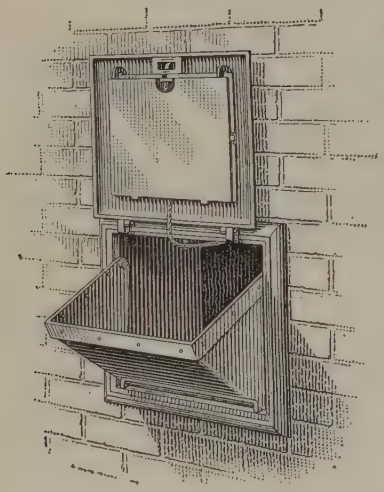


FIG. 20

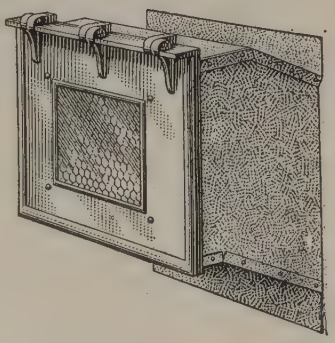


FIG. 21

140. Windows and Doors.—The windows in the living-room bay and in the bedroom No. 1, are double-hung windows. The window below, in the basement, is a single-sash window. On either side of this window are cast-iron coal chutes, Fig. 20, consisting of a cast-iron chute and a door. The door may have a light of wire glass in it if desired, as shown in Fig. 21. This door is provided with a chain by which it can be held shut from the inside.

The windows in the kitchen wing are double-hung in the upper floors and single-sash windows in the basement.

The center windows in the sleeping porch are casements with fixed sash at each side. The doors to the kitchen and the basement entry have glass panels in the upper parts, with wood panels below. The door to the basement is shown by broken lines, as the door is behind the stoop.

141. Dormers.—The dormer in the attic bedroom is shown with its three double-hung windows. The sides and the sloping roof are covered with shingles while the flat roof on top is covered with tin.

All the other indications are the same as already described, although this elevation should be carefully studied.

142. Gable.—A gable is shown over the kitchen wing. The face of the gable being vertical, it is treated in the same manner as the other outside walls. The lower slope of the roof is, however, carried across to carry out the design.

A *barge board* and moldings are shown running up the inclined edges of the gable. A small window is placed in this gable to give light in the attic space over this wing of the house.

143. Steps.—The steps to the basement from the grade, or ground level, are shown in this elevation by broken lines, and pipe rails are indicated at *b*. All the outside steps except those to the service porch are built of concrete, which is provided with reinforcement as would be shown in details that are generally furnished by the architect after the working drawings are completed.

TRANSVERSE SECTION

144. General Features.—The Transverse Section, which is taken on the line *A*–*B* of all the floor plans, has been referred to from time to time in connection with the drawings already discussed; and the indications which appear on it have been described with their relation to the corresponding indications on the other drawings in the set.

The Transverse Section shows the building as it would appear if the part in front of the line *A–B* were removed. The line *A–B* on each floor plan is taken so as to pass through the features of which it is desired to show the construction and appearance. For this reason, examination of the section lines *A–B* and *C–D* on the plans of the different floors will show that the sections indicated are not in all cases directly one above another. Therefore, it is advisable to compare carefully the courses of the section lines on the different plans and to take notice of the construction shown for each floor in the Longitudinal and the Transverse Sections.

LONGITUDINAL SECTION

145. The Longitudinal Section differs from the Transverse Section in the fact that it is taken lengthwise of the building. It shows the parts that would be seen by a person looking from the front toward the rear of the building, as they would appear if the parts in front of the line *C–D* were removed. This section should be carefully studied and compared with the parts of the floor plans which it shows.

READING ARCHITECTS' BLUEPRINTS
(PART 3)

INDICATIONS USED IN DRAWINGS
(Continued)

FRAMING PLANS AND ELEVATIONS

1. The drawings such as shown in the blueprints that accompanied *Reading Architects' Blueprints,* Part 1, and which have been described in detail in Parts 1 and 2, are the ones usually furnished by the architect as the general working drawings of the building. They do not, however, supply all the information required for construction purposes, and it is necessary that the architect furnish scale and full-size details to explain more fully many of the ideas indicated on the quarter-inch-scale drawings.

One feature that is seldom shown in the form of drawings is the arrangement of the joists in the floors or the studs in the elevations. Framing drawings are seldom given for such work, all the timber construction usually being left to the judgment and experience of the building foreman. Unless there are special features or difficult problems in connection with the work, this arrangement is usually satisfactory.

Because, however, a knowledge of how floors and walls are framed will be a help in understanding plans in general, there will now be given drawings showing the framing of the first floor and the south wall of the building shown in the blueprints described in the preceding Sections.

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These drawings, shown on the accompanying plates entitled Framing Plan of First Floor, and Front-Elevation Framing, are at a scale of $\frac{1}{8}$ inch = 1 foot, though they are usually made at a scale of $\frac{1}{4}$ inch = 1 foot as indicated by the legend on each.

2. Framing Plan of First Floor.—In making such a drawing as the Framing Plan of First Floor, the parts of the building that support the frame, such as concrete foundation walls, pipe columns, and the chimneys, are first drawn in thin, or faint, lines. Next are shown all the openings between the basement and the first floor, such as those for stairs, chimneys, flues, floor registers, hearths of fireplaces, etc. When all these openings are drawn the framing around them is laid out.

It will be seen that on each side of the living-room fireplace the joists are doubled, forming trimmers *c*. If these have a bearing on a chimney, the chimney must be so arranged that the ends of the trimmers will be distant not less than 8 inches from any flue or fireplace, in order to avoid danger from flame and heat.

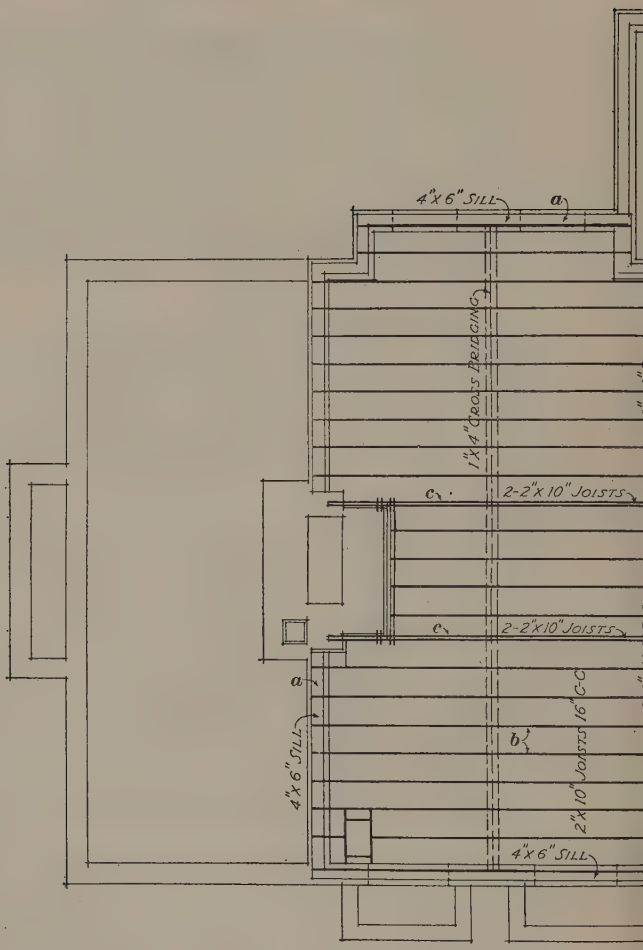
A header *i* is supported on the trimmers by means of bridle irons, or iron joist hangers *j*. The header is indicated by two heavy lines which represent two 2-inch joists. The light lines on the sides of this header indicate cleats for supporting the joists *k* and the trimmer arch that extends from the chimney to the header *i*. The other ends of the trimmers rest on a similar cleat that is spiked to the girder *h*, or they may be supported by bridle irons or joist hangers attached to the girder *h*. Small openings, such as those for heat flues, do not require the joists to be doubled around them, but are framed as shown at *l*.

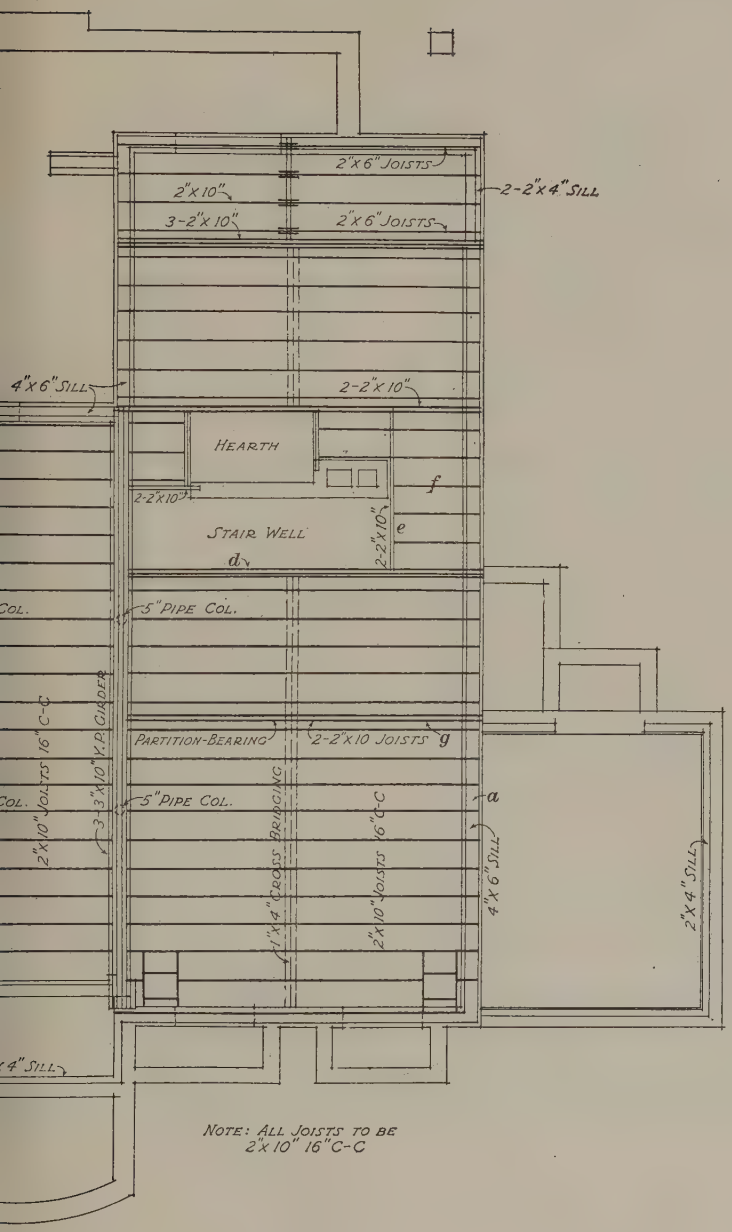
The girders *h*, consisting of three 3″×10″ timbers, are shown by three heavy lines. The two thin lines on the sides indicate cleats upon which the joists rest The locations of the columns that support these girders, also of the column caps, are shown by dotted lines. On the header *m* are indicated hangers which support the 2″×6″ joists of the service porch.

FRAMING PLAN · FIRST FLOOR ·

SCALE

0 3 6 9 12





Note: All Joists to be
2"x10" 16"C-C

When partitions resting on this floor run in the same direction as the joists, double joists should be placed under the partitions, as at *g*.

After the joists mentioned are placed in their special positions, the spaces between them are filled in with single joists, as shown by the single black lines. These joists are spaced 16 inches apart on centers, and lines of cross-bridging are put in place as indicated by the broken lines in the plan. Joists should be placed close against the outer wall studs where the walls are parallel to the joists. When the walls are at right angles to the joists, the joists should extend past the studs to the inner face of the sheathing in the walls and should be spiked to the sides of the studs.

3. Front-Elevation Framing.—The framing of the south wall is shown in the plate entitled Front-Elevation Framing. In beginning the framing, the corner posts *a* at each end are laid out and set on the sills *b*. The studs are spaced evenly across the entire front at distances of 16 inches on centers, their upper ends reaching up to the plate *g*. The studs are then cut out to accommodate the window frames, and the openings thus made are framed around with double studs as shown at *d*.

To support the wall over the vestibule, a header, or girder *e*, consisting of two 2″×10″ timbers, is located as shown; also a header *f* consisting of two 2″×6″ timbers is placed over the front-door opening in the vestibule.

The rafters, as shown, are spaced 24 inches on centers, and the dormer openings are placed so that it is necessary to cut only one rafter. The rafters are doubled on each side of the dormers, however.

The lookouts that support the eaves are placed as shown by the profiles at each end of the plate. The framing of the side porch and breakfast porch is also as shown. It will be profitable to study these framing plans in connection with the blueprints.

DETAILS

4. As has already been mentioned, besides the quarter-inch-scale blueprints of the plans and elevations, the architect will furnish larger-scale or full-size drawings, or details, for many of the parts of the building which, because of their size, form, or construction, cannot be plainly shown on the quarter-inch-scale drawings.

A selection of such details will now be considered and their indications explained. These details are generally given to the contractor in the form of blueprints, the original tracings being kept in the architect's office so that additional prints can be made at any time they are required. Some of these details will be here shown in the form of blueprints.

CELLAR OR BASEMENT WINDOW

5. In Fig. 1 is shown a blueprint of a typical detail of a cellar window. At the left, the window and nearby parts are shown in elevation, with a portion broken out of the middle as indicated by the two irregular lines, and on the right are shown sections taken at the places indicated by the lines *A-A*, *B-B*, and *C-C*.

To make plain the construction indicated in the details, Fig. 2 is given, which shows in perspective how the different parts would look if they were actually cut at the points where the sections are taken.

6. Fig. 1 is drawn at a scale of $1\frac{1}{2}'' \times 1'\,0''$, or at one-eighth the actual size of the construction. In the study of this detail, it will be good practice to measure off the various parts by use of an ordinary rule such as carpenters use. Then, since the detail shows the parts at one-eighth their actual size, each $\frac{1}{8}$ inch on the rule represents 1 inch on the detail. Thus, the sill marked $4'' \times 6''$ on the detail will be found to measure $\frac{4}{8}$ inch $\times \frac{6}{8}$ inch.

At *v* and *z* two portions of the drawing are shown at a scale of $3'' = 1'\,0''$, or one-fourth full size, in order to make

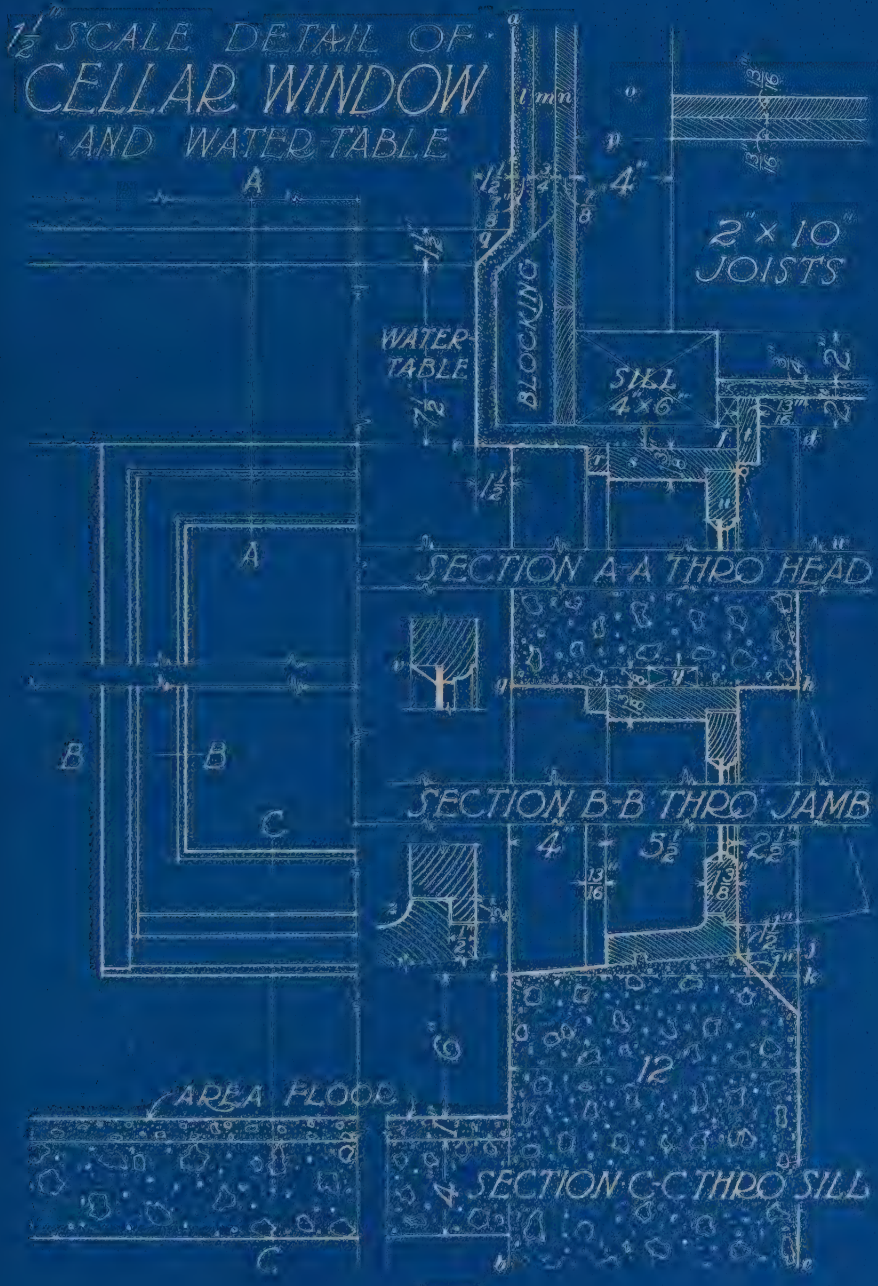

1½" SCALE DETAIL OF
CELLAR WINDOW
AND WATER TABLE
WATER TABLE
BLOCKING
SILL 4"×6"
2" × 10" JOISTS
SECTION A A THRO HEAD
SECTION B-B THRO JAMB
SECTION C-C THRO SILL
AREA FLOOR
A
B
C
12

FIG. 1

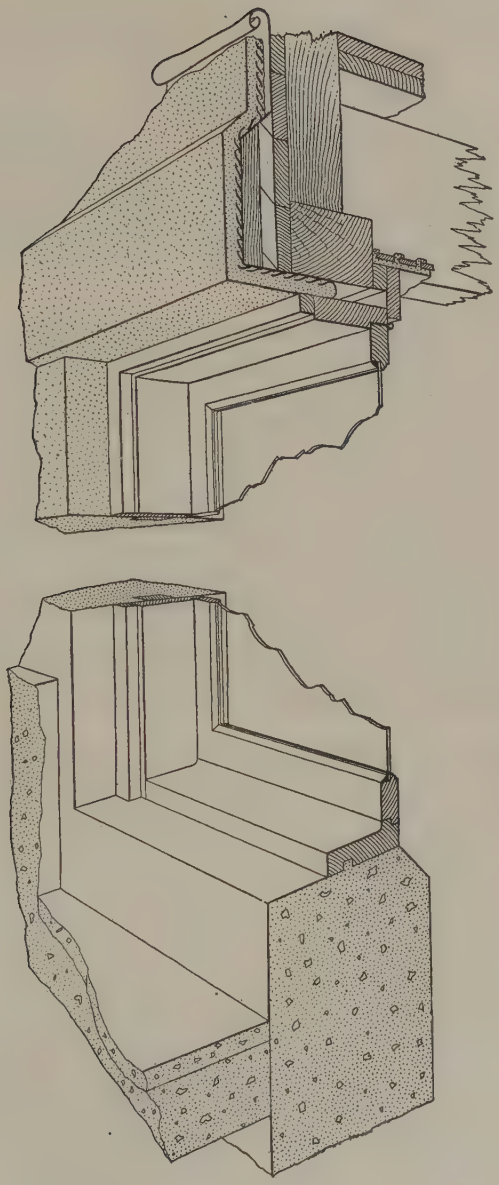


FIG. 2

clear the shape of certain parts of the detail that cannot be seen plainly at the smaller scale. In this case, each ¼ inch on the rule represents 1 inch on the detail.

7. The first impression received by a person looking at Fig. 1 is that the drawing is broken up into parts. In details drawn at large scale, only such parts are drawn as are necessary to show the construction to be used and those adjacent parts that come into immediate contact with the part that is being specially detailed.

In Fig. 1, for instance, the part of the window shown in the elevation on the left is sufficient to illustrate the entire window, and it is not necessary to show the whole pane of glass. Likewise, in the sections *A-A*, *B-B*, and *C-C*, the glass is cut off by broken lines close to the sash. This method results in less work for the draftsman, makes the drawing more compact and easily handled, and saves paper. The principle is applicable to all details and is commonly used.

8. The section *A-A* is taken through the head of the window; and since the lintel of the basement window is formed by the water-table, it is customary to show the construction of this water-table in connection with the detail of the window head.

The sill of the building is indicated to be of timber by the diagonal lines, and one of the first-floor joists is shown resting upon it. The joist is shown notched down so that its lower surface is 2 inches below the top of the sill. Since the joists are 2″×10″ in size, their tops will be 8 inches above the top of the sill. This can be verified by measuring with the rule.

Resting on top of the sill is a 4-inch stud *o*. The top edge of the joist is shown extending to the sheathing *n* on the far side of the stud, as is indicated by the broken line *p*.

The sheathing *n* is nailed to the studs and to the sill, and the furring *m* is secured to the sheathing. Upon the furring the lath is stretched to hold the stucco *l*. The water-table, which is formed of plaster or stucco, is blocked out so that it projects 1½ inches beyond the face of the wall as shown. The under side of the water-table forms the bottom of the window lintel;

the stucco is forced in over the top of the window frame, and the molding *r* is nailed close up against the plaster to make a tight joint.

The plaster ceiling of the basement is shown on the under side of the joists.

The cellar window frame is of wood, as indicated by free-hand hatching. The head of the frame is shown at *s*, the staff bead or molding at *r*, the sash at *u*, and the inside trim, or architrave, at *t*.

9. The section *B-B* is taken through the jamb, or side of the frame, and, the window being a casement window, the construction of the jamb is essentially the same as that of the head. The wooden strip *y* may be placed in the form and the wall cast around it. Then the frame, when it is afterwards set in the wall, can be nailed to the strip and will be held securely in place. If, however, the frame is set in position before the wall is poured, the strip is nailed to the side of the frame and the concrete when cast against the frame encloses the strip. In either case the frame is held securely to the wall and the strip forms an air stop.

At *v* is shown an enlarged detail of the molding of the sash rail.

10. The section *C-C* is taken through the sill, and the finish of the wall beneath the sill is shown. The masonry sill is formed of concrete and is 6 inches above the area floor, as indicated by the dimension. The wood sill is made of 2-inch material, but in the process of making its actual thickness is reduced at least $\frac{1}{4}$ inch. The wood is set at a slope to shed water, and has a rabbet formed in it corresponding with a rabbet in the bottom of the sash, as is shown at a larger scale at *z*. The curved raised part of the sill at *z* is devised to prevent rain from being blown through the joint.

The concrete wall inside the window sill is splayed so as not to hold dust and not to intercept light.

A groove is ploughed in the bottom of the sill and the concrete will work up into this groove when it is poured, and thus form an air-stop.

Concrete and plaster are indicated similarly in elevation, but it should be easy to determine from the general construction which material would be used.

The broken slanting line extending from the head to the sill indicates the swing of the sash, and that it is hinged at the top.

DOUBLE-HUNG WINDOW IN A WOODEN WALL

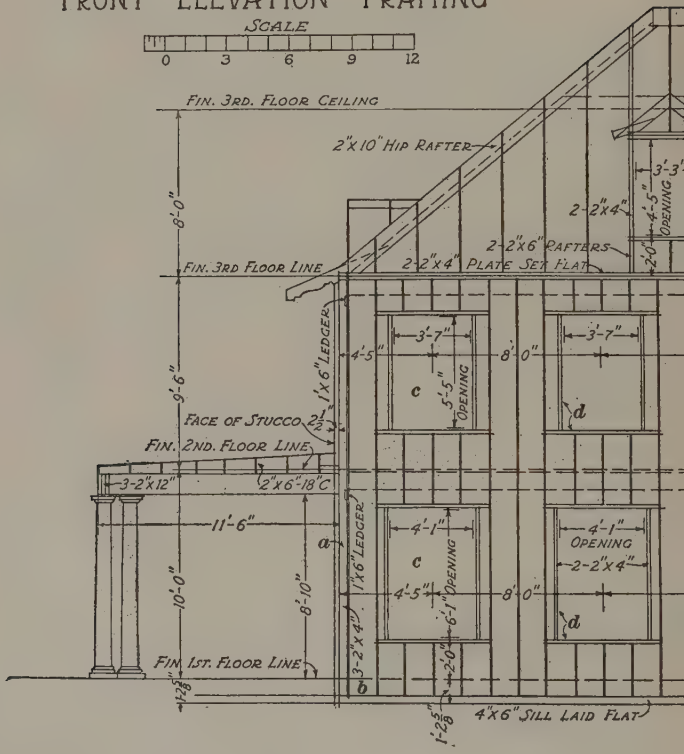
11. In Fig. 3 is shown a detail of a double-hung window in an ordinary frame building covered with plaster, or stucco. This drawing is shown in the figure at one-sixth its actual size, or at a scale of $2'' = 1'\,0''$. It will therefore not be convenient to measure for this drawing unless the rule used has inches subdivided into 12 parts. These measurements can however be taken with an architect's scale, by using the 1-inch scale, in which 1 inch equals 1 foot, and calling the dimensions one-half of what they read at that scale.

This drawing is similar to the detail of the cellar window, in that it shows parts of the exterior elevation of the window, and three sections. In addition to these features, however, it shows parts of the interior elevation. In the study of this detail, it will be found helpful to refer also to Fig. 4, which shows in perspective the sections and parts of the same window represented in Fig. 3, and, with one or two exceptions, has the parts lettered the same.

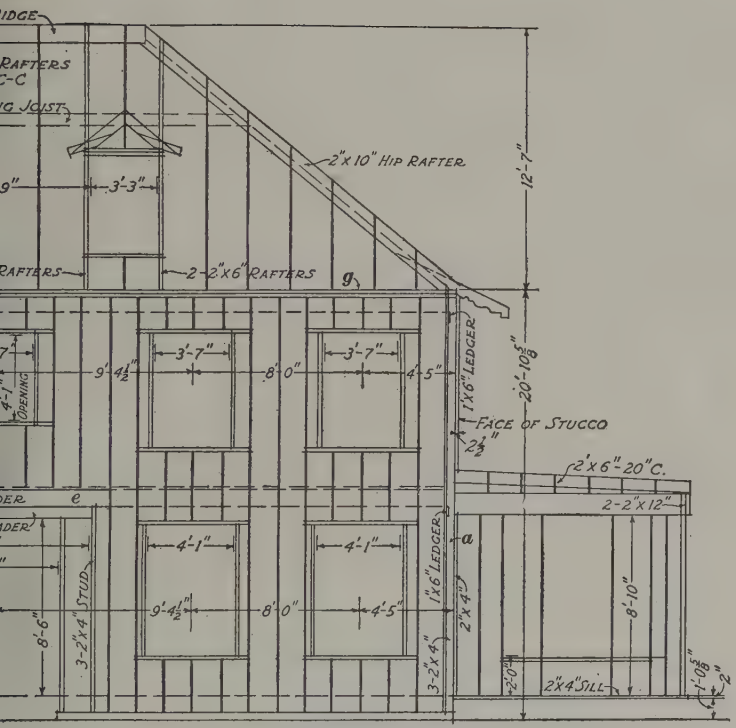
12. In the section through the head, the double $2'' \times 4''$ timbers across the top of the frame, which constitute a header, are shown by rectangles *d*, the fact that they are of wood being indicated by the diagonal lines. Vertical studs rest on this header, and the sheathing *e* is nailed to them. On the inside of the studs are the lathing and plastering *f*. On the inside of the header is a wooden strip *g*, called a *ground*, which serves to regulate the thickness of the plaster and furnishes a support to which the inside trim is nailed.

On the outside of the sheathing, at the top, is shown furring *h*, to which plastering or stucco is applied. The metal lath is indicated by the **S**-shaped lines in the plaster, which

FRONT ELEVATION FRAMING



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NOTE: ALL WINDOWS ARE FIGURED FROM FLOOR LINE TO ROUGH SILL.

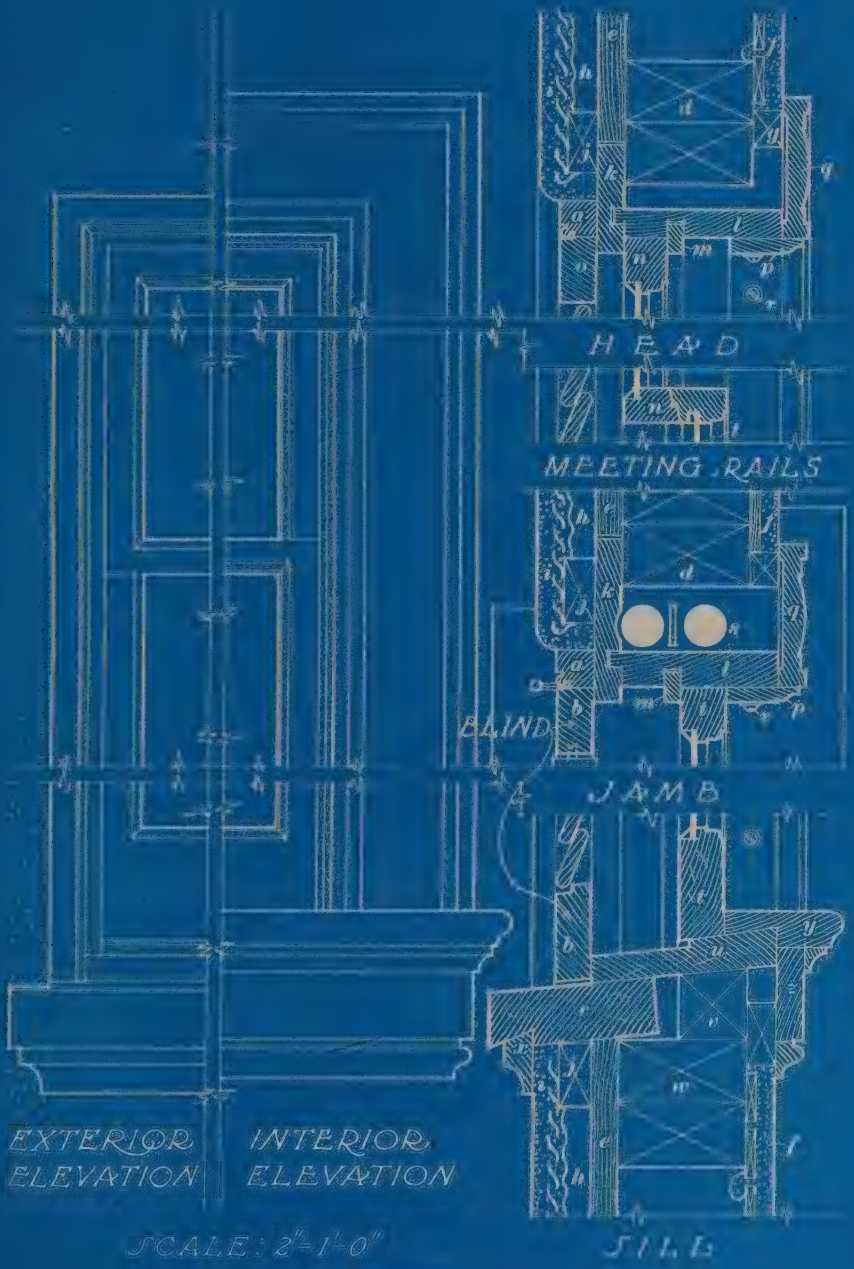

HEAD
MEETING RAILS
BLIND
JAMB
SILL
EXTERIOR ELEVATION
INTERIOR ELEVATION
SCALE: 2"=1'-0"

FIG. 3

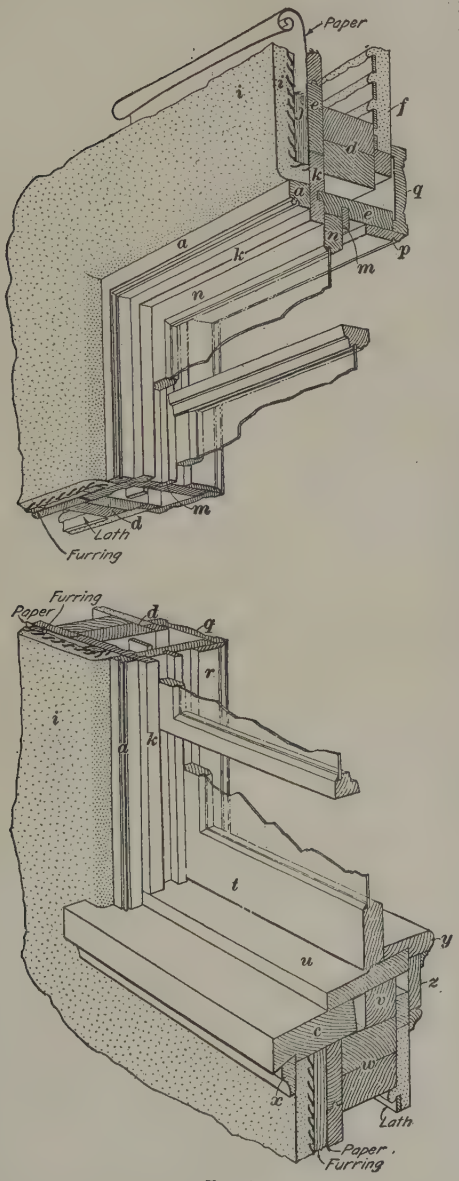


FIG. 4

is represented by dots. The plastering is carried around the blocking *j*, against the outside casing *k* of the window frame. The staff bead, or blind stile *a*, is nailed in the corner. At *l* is the head of the window frame. The piece *m* is the parting strip that keeps the sash apart at a fixed distance. At *n* is the upper sash, which slides down. At *o* is the upper rail of the blind; at *p*, the stop bead which keeps the inner sash in place. The inside trim, or architrave, is shown at *q*, and at *r* are seen adjusting screws which hold the stop bead to the head and sides of the frame, but at the same time permit the stop bead to be adjusted.

13. In the section through the meeting rails is shown the bottom of the outer sash, and the top of the inner sash, as they meet when the window is closed.

14. The section through the jamb is very similar to that through the head, except for the weight box, which is formed by keeping the double studs *d* back from the pulley stile *l*, so that sash weights *s* may be accommodated. These sash weights are indicated by the white circles. The small rectangle between the weights represents a *pendulum* strip which is hung from the top of the box, and is intended to keep the weights from striking each other as they move up and down inside the box. The weights are used to counterbalance the sash, and they move up and down as the sash are moved in the opposite direction.

15. The section through the sill has several features not shown in the other sections. The bottom rail *t* of the inner sash is shown resting on the sill *u*, which is set at a slant so as to shed water. The sill rests on the subsill *c*, which extends out in front of the plastered face of the wall, and has a mold *x* beneath it. The appearance of this sill in elevation is shown in the exterior elevation of the window.

Inside the window, the stool *y* rests on the sill, and beneath the stool is the apron *z*, with bed molds at its upper and lower edges. The appearance of this feature is shown on the interior elevation. It will be noted that the stool and apron are returned against the interior plaster. This is shown in the section through the jamb, where the letter *f* is placed. It is also shown on the interior elevation.

MAIN CORNICE

16. In Fig. 5 is a blueprint of a simple form of a projecting cornice, or eaves. This detail consists of a section through the cornice, and a partial elevation.

The wall, as shown at *a*, is of the same construction as that shown in Figs. 3 and 4, and consists of studs, sheathing, furring, outside stucco, and inside plastering. A 1″×5″ ledger board is shown supporting 2″×10″ attic joists. On top of these joists is the 4″×4″ plate, made up of two 2″×4″ pieces, and indicated by diagonal lines as timber. The sheath-

SECTION THRO'
MAIN CORNICE
SCALE: 1½" = 1'-0"



ing and the other wooden parts are hatched to indicate finishing lumber. The plaster is dotted, and the sheet metal of the gutter is marked by vertical lines. A $\frac{7}{8}$″ thick anchor which holds the rafters in position is shown by broken lines.

At *b* and *c* is shown blocking to which the fascia *d* and the two bed moldings are secured. The lookouts *e* are of the thickness and spacing described on the drawing, and for support are extended into the building and spiked to the rafters. The blocking *c* is cut in between these lookouts. The lookouts can also be spiked to the sheathing or plate if desired.

On top of the lookouts are nailed matched and V'd ceiling boards. The tongues and grooves show plainly in this detail, as do the slightly beveled edges which form the V's.

At *f* is a small fascia, nailed to the ends of the lookouts, and against this the gutter rests. This gutter is a plain half-round gutter formed of sheet metal. The lower part is curved, and the upper part extends up under the shingles as shown by the heavy white line. A metal strap *g* holds the outer edge of the gutter firmly in place and is nailed to the roof under the shingles. The shingles are shown with a double row at the bottom of the slope *h*.

At *i* is indicated the wood lathing and the plastering with which the interior walls and the ceiling are covered.

KITCHEN DRESSER

17. In Fig. 6 is given a detail of a kitchen dresser; this drawing consists of an elevation, a plan, a side elevation, and a section. There are also given a series of larger-scale sections through various parts of the dresser, to show its construction.

The elevation shows, in its lower part on the left, two large drawers and two small ones. At the right, a cupboard or pot closet with a single shelf is shown. Over this part is a shelf, called a counter shelf, extending back to the wall. This will be seen very clearly in the side elevation and in the sections. Above the counter shelf is a closet with shelves and glazed doors in front of them.

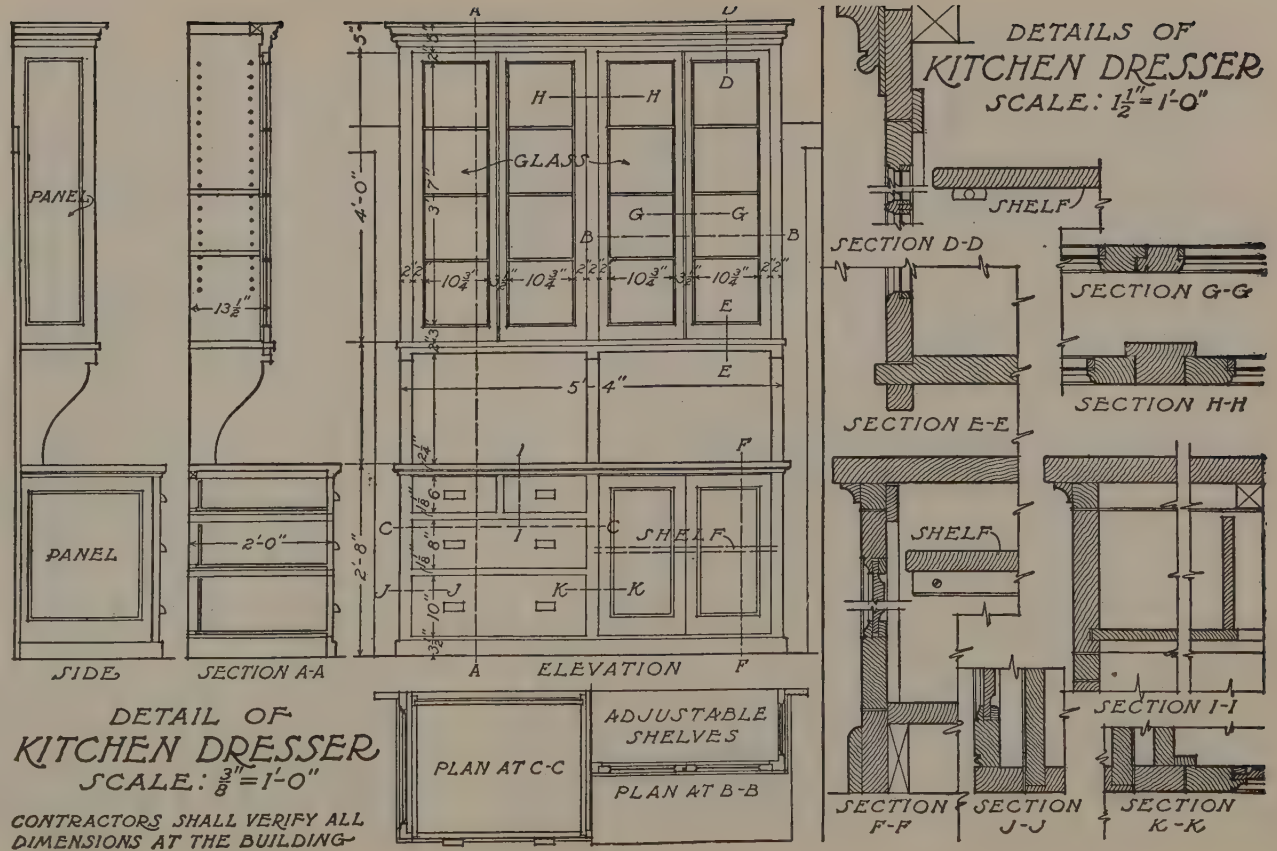

DETAILS OF
KITCHEN DRESSER
SCALE: 1½" = 1'-0"
SHELF
SECTION D-D
SECTION G-G
SECTION E-E
SECTION H-H
SHELF
SECTION I-I
SECTION F-F
SECTION J-J
SECTION K-K
PANEL
PANEL
2'-0"
SIDE
SECTION A-A
A
D
H
H
D
GLASS
G
G
B
B
E
E
5' 4"
F
F
C
C
SHELF
J
J
K
K
4'-0"
2'-8"
A
ELEVATION
F
DETAIL OF
KITCHEN DRESSER
SCALE: ⅜" = 1'-0"
CONTRACTORS SHALL VERIFY ALL
DIMENSIONS AT THE BUILDING
PLAN AT C-C
ADJUSTABLE
SHELVES
PLAN AT B-B

FIG. 6

The section *A-A* shows a slice through the dresser on the line *A-A* in the elevation.

18. The details at the scale of $1\frac{1}{2}=1'\,0''$, or one-eighth actual size, can be measured by using the rule and calling each eighth of an inch one inch. Each section is marked with letters corresponding to those on the elevation, which indicate where the section is taken. The indications are for dressed lumber, and the construction is that customarily used.

Careful study of these sections, and comparison of them with the various parts of the drawing, will give a good understanding of the methods commonly employed in representing such work so that a workman skilled in his trade will be able to construct the object shown.

PLANS OF A SCHOOL BUILDING

19. General Explanation.—A masonry building will now be considered. This building is a six-room schoolhouse having foundations of concrete, exterior walls of brick, and trimmings of stone and terra cotta. The roof is covered with slate, and the gutters, hips, ridges and cupola are covered with sheet metal, either copper or galvanized iron.

On the first floor are three class rooms, and on the second floor three more class rooms and a room for the principal. In the basement are two play rooms, two toilets, and space for the heating and ventilating apparatus. There are also the entrances, halls, corridors, and stairs that are necessary for access to the various rooms.

The class rooms are the principal features in this building, and they occupy the larger parts of the first and second floors.

20. The design of a school building presents special problems. A large number of pupils must be taken care of in the class and play rooms. These rooms should therefore be provided with sufficient heat and fresh air. There should be sufficient light coming in over the left shoulders of the pupils as they sit at their desks. Entrances and exits should be

planned for convenience. The safety of the scholars should be assured by providing large, wide corridors and ample exits. The doors should all open outward so that the exits cannot be blocked by the doors being closed.

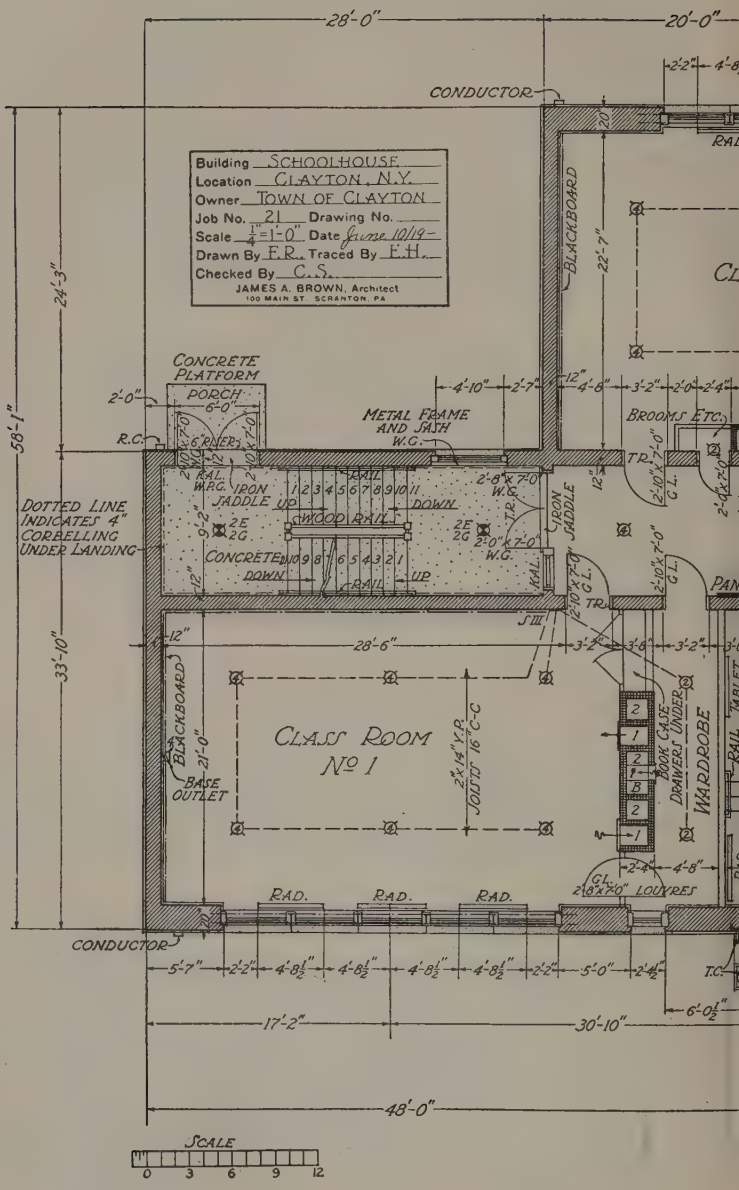
21. Every school building should be built so as to comply with state and local laws, which vary in different localities. In the preparation of the plans shown herewith, all these matters have been considered, and the plans would be acceptable to most authorities, and satisfactory for the erection of a good schoolhouse.

22. Drawings.—The drawings shown are the Basement Plan, the First-Floor and the Second-Floor Plans; the Front, and the Side Elevations, also a number of details, as Figs. 12 and 13. A set of drawings such as this is sufficient for a contractor to estimate from. Additional details, both scale and full size, would be made as the work progressed. The details here given show features that are peculiar to school buildings of the character shown. In many respects the drawings are like those described in *Reading Architects' Blueprints,* Part 2.

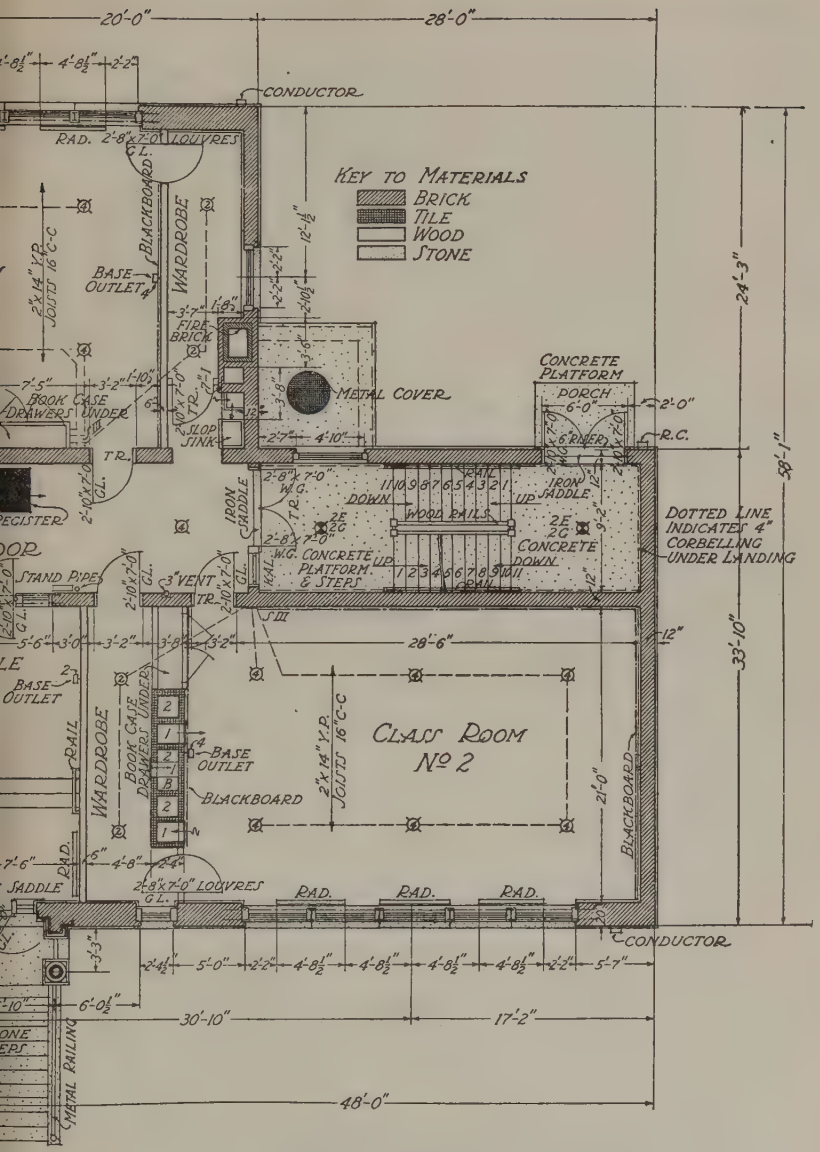
FIRST-FLOOR PLAN

23. The First-Floor Plan will now be considered. In studying parts of any drawing, the other drawings that show these parts, either in elevation, section, or plan, should be consulted so that all information given regarding these parts may be obtained.

24. Main Entrance.—The main approach to the building is up a flight of eleven steps, leading to a large platform. These steps and the platform are dotted and marked *Stone Steps.* The steps have stone cheeks which can be seen in the Side Elevation. These cheeks support metal newels and hand rails. The cheek walls are themselves supported on foundation walls which extend into the ground 3 or 4 feet so as to be below the influence of frost. These foundation walls are shown in the Basement Plan. Between the foundation of the


Building SCHOOLHOUSE
Location CLAYTON, N.Y.
Owner TOWN OF CLAYTON
Job No. 21 Drawing No.
Scale 1/4"=1'-0" Date June 10/19-
Drawn By F.R. Traced By F.H.
Checked By C.S.
JAMES A. BROWN, Architect
100 MAIN ST. SCRANTON, PA
28'-0"
20'-0"
CONDUCTOR
BLACKBOARD
22'-7"
24'-3"
58'-1"
33'-10"
CONCRETE PLATFORM
PORCH
6'-0"
2'-0"
R.C.
METAL FRAME AND SASH
W.C.
BROOMS ETC.
RAIL
W.P.C.
IRON SADDLE
UP
DOWN
WOOD RAIL
CONCRETE
DOTTED LINE INDICATES 4" CORBELLING UNDER LANDING
TR.
G.L.
2'-0" X 7'-0"
2'-10" X 7'-0"
12"
28'-6"
CLASS ROOM Nº 1
BLACKBOARD
21'-0"
BASE OUTLET
2"X14" Y.P. JOIST 16" C-C
BOOK CASE DRAWERS UNDER
WARDROBE
RAD.
G.L. 2'8"X7'0" LOUVRES
CONDUCTOR
5'-7"
2'-2"
4'-8½"
4'-8½"
4'-8½"
4'-8½"
2'-2½"
5'-0"
2'-4½"
T.C.
6'-0½"
17'-2"
30'-10"
48'-0"
SCALE
0 3 6 9 12

ILT 448 §7



FIRST - FLOOR - PLAN

cheeks are two walls that support the steps in between the cheeks.

In the First-Floor Plan, on the platform, are indications of columns. These are marked *T. C.*, which signifies terra cotta. These columns rest upon square bases. Against the wall back of the columns are pilasters and quoins. This work is indicated by thick lines which are approximately the thickness of the terra cotta. The sections here are too small to contain the proper indications for terra cotta as shown in *Reading Architects' Blueprints,* Part 1, but the fact that these features are marked *T. C.* leaves no doubt as to their nature.

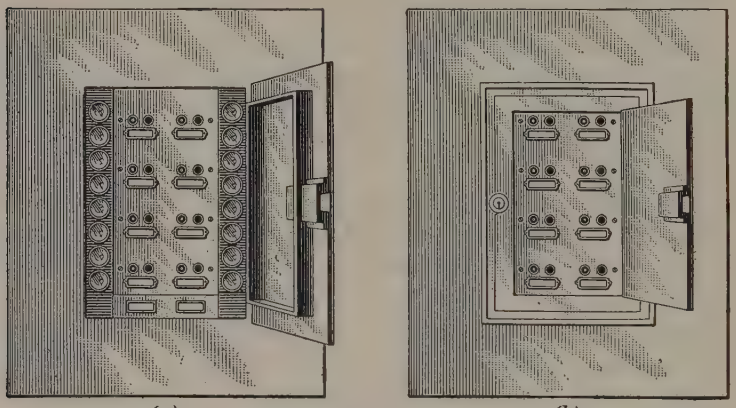
25. The doors at the entrance are double and swing outwards. Beneath them is a stone sill, forming a step from the platform to the vestibule floor. This sill is shown dotted. A brass saddle covers the joint between the stone sill and the wooden floor.

On either side of the doors, sidelights are indicated in the plan. The Front Elevation shows them to contain single sheets, or lights, of glass which are about of the same height as the glass in the doors. The indication *TR.*, on the plan, shows that there is a transom over this door. This appears in the Front Elevation. Over the platform is an ornamental canopy which is formed of terra cotta and is supported on the columns and pilasters. A side view of this canopy, the columns, and pilasters, is given in the Side Elevation. A lantern of wrought iron supported upon wrought-iron brackets is shown on the Front Elevation. This lantern is equipped with electric lights, and the indication on the First-Floor Plan shows outlets for four lights.

26. Vestibule.—The vestibule shown on the First-Floor Plan is divided into two parts by a short flight of stairs, three risers being shown. These stairs have hand rails against the walls on each side. On the wall on the left side is shown a notation indicating that a tablet of iron or bronze will be placed there. This tablet may contain the name of the school, the names of the building committee, the architect, and the contractor, as well as the date when the building was erected.

Just inside the door is an indication of three switches. One of these controls the light in the lantern over the porch, another controls two lights in the vestibule, and the third controls one light in the corridor. Thus a person entering at night may turn on the lights in the corridor which will enable him to see the panel board, where he can turn on additional lights as required.

A notation on the floor of the vestibule gives the information that 2″×14″ yellow pine joists 16 inches on centers are used in the larger portion of the vestibule, and 2″×12″ joists



(a) (b)

FIG. 7

in the smaller portion. This implies that the flooring will be of wood in both portions.

From the vestibule, a pair of doors leads to the corridor. These doors have a side light on each side, and are indicated as double-swinging and glazed. A transom is indicated that will probably extend over both the doors and the side lights. These doors, as well as the front doors, would be constructed from scale and full-size details. The partitions on each side of the vestibule are indicated as stud partitions plastered on both sides.

Other indications in the vestibule are two ceiling outlets for four lamps each, one base outlet for two lights, and two radiators.

27. Corridor.—The corridor connects the vestibule with the stair halls. It also contains the entrance doors to the three class rooms and the wardrobes. All the doors to these rooms open outwards into the corridor so as not to interfere with the pupils coming out in case of fire or panic. The indications at these doors are *GL.* for glass panels, and *TR.* for transoms.

28. A panel board is indicated in the corridor. This board holds all the switches that control the lights in the first-story rooms. In Fig. 7 is an illustration of a panel board of the safety type that would be used in this position. The switches are operated by push buttons. There are practically two doors, both of which are shown open in (*a*), where the fuses and the push buttons are visible. In (*b*) the door that covers the fuses is closed, leaving only the push buttons exposed. Both doors may be locked to prevent tampering with the switches.

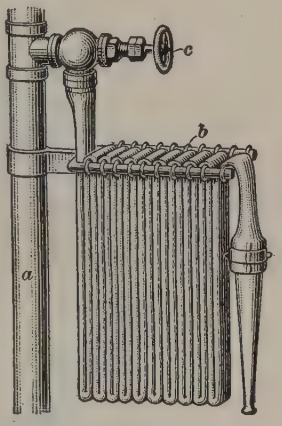


FIG. 8

29. A standpipe is indicated in the corridor and consists of a vertical water pipe, as *a*, Fig. 8, to which is attached a hose *b* with a nozzle. The standpipe connects with the public water supply or with a tank of water on the roof. In case of a fire the hose is pulled off the rack and the valve *c* is turned. The water is then forced through the hose.

30. Opposite the entrance to the corridor is a double circle which indicates a drinking fountain. This fixture is specified and the style and make mentioned in the specifications. A drinking fountain is illustrated in Fig. 9. This fountain is of the bubbling type. At *a* is the pipe through which water is supplied. This pipe runs up through the waste pipe *b*, and the water bubbles out through the opening at *c*. The

bowl *d* which catches the water as it falls is made of porcelain. The bowl *e* is made of enameled iron, as is also the standard *f*. Valves to regulate the flow of the water are shown at *g* and *h*. Fountains of this type provide a sanitary method of supplying drinking water to the pupils.

31. A large floor register is indicated in the corridor. Such a register, on which pupils can stand, is especially valuable in a school building, as pupils often arrive at school chilled or with wet clothing or feet, and the register furnishes means

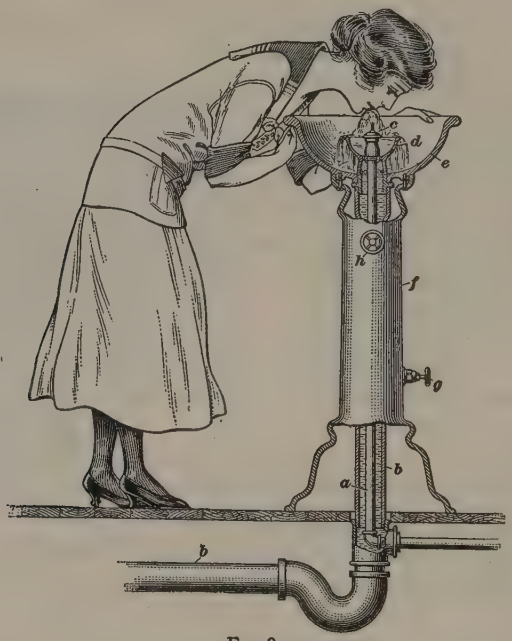


FIG. 9

for quickly drying and warming them so as to avoid danger of sickness.

32. Fireproof Stairways.—At each end of the corridor are fireproof stair halls. The walls between the stair halls and the rooms, as well as the outside walls, are of brick and are 12 inches thick. A pair of doors open from the corridor

to each stair hall. These doors together with the side lights and transoms are indicated as kalamine, or metal-covered, with polished wire-glass panels. These doors open outwards from the corridor into the stair halls. Beneath these doors are placed iron saddles, under which the wooden floors of the corridors and the cement floors of the stair halls meet. The stairs are of cement, or concrete, as is also the floor of the stair hall. In order to prevent slipping, the stairs have special treads and nosings. One type of such, shown in Fig. 10, consists of a casting having grooves of the form shown, some of which are filled with a patented non-slipping preparation. The landings at the ends of the flights leading to the basement are of concrete construction. These landings are below the level of the first floor, and just one step above the grade level. A pupil entering the building will have to ascend one-half of a story to reach the first floor, and descend one-half a story to reach the basement. Hand rails are shown on each side of the stairs, the small squares at the tops of the runs or flights indicating newels.

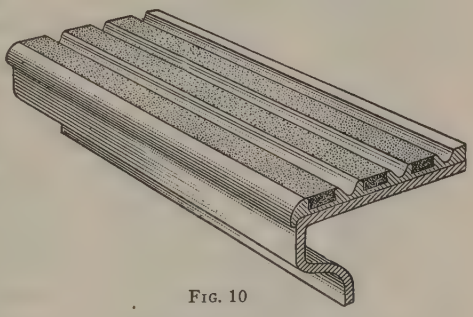


Fig. 10

33. The stair halls are lighted by windows on each floor, and by the glass panels in the doors that lead to the playgrounds. There are also combination lighting outlets indicated, for two electric lamps and two gas jets, so that when the building is occupied at night there will always be light in the halls.

The risers are indicated by numbers starting with number 1 at the bottom in each run.

34. Yard Entrances.—Entrances to the stair halls are shown on either side of the building. The plan shows a slab of concrete at the ground level and a stone sill one step above

this slab. Double doors opening out are shown at these entrances. As these doors are in a fireproof stair hall they are indicated as kalamine doors, with wire-glass panels. Over each of these doors is a canopy, one of which is seen in the Side Elevation; this canopy consists of a sheet-metal roof with a metal cornice and gutter all around, and is supported at its outer edge by chains that are bolted to the wall, and the end of the canopy against the wall is supported on the wall. The plan of the canopies can be seen in the Second-Floor Plan, the diagonal line indicating a slight depression forming a gutter in the roof.

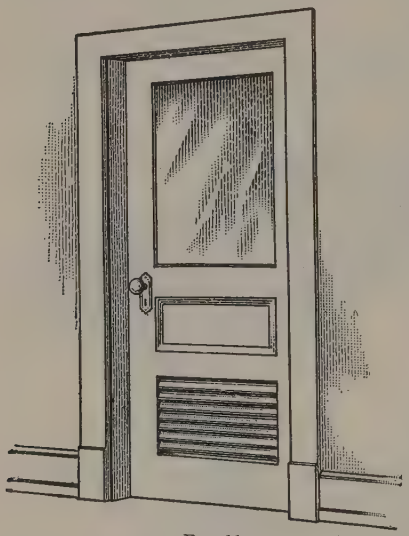


FIG. 11

The yard entrances are shown on the First-Floor Plan, notwithstanding they are a half-story below the first-floor level. They will therefore not be shown on the Basement Plan.

35. Class Room No. 1.—The three class rooms opening off the first-floor corridor are numbered 1, 2, and 3 for identification. These rooms are practically the same in size, and each will accommodate about 42 scholars. Each has, in connection with it, a wardrobe where the scholars may hang their hats and coats, and also deposit umbrellas, rubbers, etc. Class room No. 1 is entered from the corridor by a single door opening out. This door is marked *2′ 10″×7′ 0″ GL. TR.*, meaning that the door is 2 feet 10 inches wide and 7 feet high, with a glass panel, and that there is a transom over the door.

36. Another entrance to the class room is through the wardrobe. The door to this wardrobe is the same in size and construction as the class-room door, but does not have a tran-

som. A door from the wardrobe to the class room is also seen near the outside wall. This door is double-acting, as the pupils will use it when entering and leaving the class room. The lower panel of this door, instead of being made solid, is composed of louvres, or slats, or else a coarse wire mesh, so that air can be drawn into the wardrobe and out at the ventilating flue. The upper panel may be of glass. Such a door is shown in Fig. 11.

37. Just inside the class-room door is a bookcase, fitted with shelves and drawers. The doors of the bookcase are glazed, and are fitted with locks. This bookcase would be constructed from details.

38. Blackboards are indicated on the sides of the room, the indication being a dash-and-dot line. The construction of the blackboard is shown in the detail sheet, Fig. 12, which will be studied later.

39. The windows of this class room consist of five double-hung windows in one large group. This arrangement provides an abundance of light, and reduces the tendency to shadows. Mullions are shown between the windows. These mullions must contain the weights for the sash, and also **I** beams as shown which support the lintels over the windows. These lintels are shown by heavy dot-and-dash lines and are composed of two 6-inch channels and one 4″×4″ angle. This lintel is also shown in section in the typical section at the side of the Front Elevation as well as in the detail sheet, Fig. 13, which will be described later.

40. Heating and ventilation is provided by means of the stacks or ducts between the class rooms and the wardrobes. The indications for heating and ventilation given in *Reading Architects' Blueprints*, Part 1, are used here. The flues marked *B*, *1*, and *2* show the supply and exhaust ducts. The arrows indicate the direction of the air-currents to and from these ducts. The arrows having straight shafts are used for the supply ducts and those having wavy shafts for the exhaust ducts. The registers at the openings to supply ducts are indi-

cated by heavy solid lines, and the registers to the exhaust ducts by double light lines. The ducts which have no openings on the floor are marked with the number of the floor into which they open. The walls of these ducts are indicated as tile, and are 4 inches in thickness. In the middle of the group of ducts next to class room No. 1, are three ducts separated by thin lines. These lines represent sheet metal.

Radiators are shown under the windows, to be used in cold weather to supplement the heat furnished by the air ducts.

41. The class room is lighted artificially by the electric lights shown in the ceiling. Just inside the entrance door of class room No. 1, at the left, is an indication of three switches, with broken lines leading to the various outlets. One switch controls one ceiling outlet, another controls the remaining five in the class room, and one controls the two outlets in the wardrobe. The ceiling outlets in the class room are all indicated as 4-light, meaning that the wires are large enough to feed four lights of 50 watts capacity each. The baseboard outlet is for four similar lights, and each of the wardrobe outlets is for two lights. The baseboard outlet may be used for a light on the teacher's desk, or for the operation of whatever electrical equipment may be desired, such as a vacuum cleaner, magic lantern, etc.

42. Floor Construction.—An indication on the floor of the class room shows that the floor joists are 2″×14″, spaced 16 inches on centers, and that they are yellow pine. The arrows show the direction in which the joists run. The flooring will obviously be of wood, since the joists are wood, and will be carefully described in the specifications.

43. Ceiling Construction.—The ceilings, instead of being plastered, are covered solidly with $\frac{7}{8}$-inch boarding that is tongued and grooved. A metal ceiling is attached to this boarding and forms a fire-resisting ceiling. This construction is indicated in the section on the Front Elevation, also in Fig. 13.

44. Wardrobes.—The wardrobes may be entered directly from the corridor without passing through the class rooms.

Along the walls of the wardrobes are hat and coat racks, a detail of which is shown in Fig. 12. Air for ventilating the wardrobes enters from the class rooms through the louvres in the doors and is drawn out through ducts indicated by the arrows having wavy shafts. A window lights each wardrobe.

45. Class Room No. 2.—Class room No. 2 is similar to class room No 1, except that the wardrobe and entrance are at the opposite end of the room. In general the same indications appear as in class room No. 1.

46. Class Room No. 3.—Class room No. 3 does not differ materially from the class rooms just described, except that there are two entrance doors, and the heating and vent flues are on the side instead of on the end, and the bookcase is on the side of the room. The arrangement of the lighting outlets is similar. The chimney extends out into the wardrobe for a short distance and is lined with firebrick. Beside the chimney is a ventilating flue from the basement. This flue has terra-cotta walls, and is arranged to exhaust the air from each of the floors.

47. Slop Sink.—Beside the entrance to the wardrobe used in connection with class room No. 3, a slop sink is indicated. This fixture is for use in drawing and emptying the water used in cleaning the first floor.

48. Broom Closet.—A small closet is built off the corridor for the purpose of holding the brooms, mops, and other equipment used by the janitor or others employed about the building. This closet has shelves for the storage of supplies, and a lighting outlet, as much of the cleaning will be done at night.

49. Walls.—The walls on the outside of the building are brick, the front walls being 20 inches, or five bricks, thick, and 12 inches beneath the windows, as shown in Fig. 13. The side walls on the plan are 12 inches, or three bricks, thick. The walls in the rear of class room No. 3 are of the same thickness as the front walls. The walls between the class rooms and the stair halls and the corridor are 12 inches thick.

The class-room walls that are against the outside of the building are furred and plastered, as a precaution against dampness.

50. Ash-Pit.—Outside the building, near the chimney, is shown a concrete slab over the ash-pit which is seen on the basement plan. This slab has a cast-iron cover, the top being checkered to prevent slipping, and having handles so that it can be removed for the purpose of taking out the accumulated ashes.

51. Rain Conductors.—On the corners of the building are shown the conductors which dispose of the water that falls on the roof. These conductors are shown also in the elevations.

52. Dimensions.—The First-Floor Plan is fully dimensioned. It must be remembered that in actual construction the contractor lays out the building from the Basement Plan, and by the time the building is erected up to the first-floor level, the over-all dimensions of the building are established. The over-all dimensions of the first floor will thus be determined. The dimensions given on the First-Floor Plan, however, are important in locating the openings, partitions, etc., on the building, as well as for estimating purposes. A comparison of the First-Floor Plan, with the Basement and the Second-Floor Plans, will show the relation of the dimensions. It will be excellent practice to check up the measurements shown on the First-Floor Plan, by adding up the partial dimensions, and comparing the results with the total dimensions. It will also be good practice to compare the figures on one plan with those in the other plans, and find out if the windows, for instance, are so figured as to come exactly over each other in all the plans.

SECOND-FLOOR PLAN

53. General Explanation.—The Second-Floor Plan is similar to the First-Floor Plan, in most respects. It shows three class rooms, located directly over the ones in the First-Floor Plan, and these rooms have the same indications as

those below. In place of the vestibule, a principal's room is shown.

54. Principal's Room.—The principal's room is entered from the corridor by the double doors opening out. A short passage is indicated leading to the main part of the room, and on either side of the passage are supply closets, for the miscellaneous supplies for the class rooms. The supply rooms are fitted with shelves, and are lighted by fixed sash through which light comes from the principal's room, and artificially by ceiling lights controlled by switches operated by the doors. When the doors are opened, the lights are turned on automatically.

The principal's room is lighted by a triple mullion window, the general arrangement of which may be seen on the Front Elevation. In one corner of the room is shown a wash basin, with a medicine closet placed above it. The room is also lighted by a 4-light outlet in the ceiling, and a base-board outlet for four lights.

Fresh warmed air is supplied by the duct that supplies class room No. 1 on the first floor. The amount of air needed for the principal's room is small, and the duct is ample for all ordinary requirements. For very cold days, and for unusual conditions, such as a possible break-down of the fan system, or the use of the room at night, a radiator is provided under the window. The foul air is exhausted through the same duct as that from class room No. 4, as indicated by the dotted lines passing over the wardrobe connected with class room No. 4.

On the left-hand wall of the room is indicated a telephone outlet. From this outlet, the line may be extended to reach the principal's desk. The indication on this plan insures its being supplied by the contractor, who will consult the architect or the principal regarding the exact location desired.

55. Broom Closet.—A broom closet is indicated off the corridor, and a slop-sink at the entrance to the wardrobe of class room No. 6. These indications are similar to the corresponding indications in the First-Floor Plan.

56. Roofs at Entrances.—On the Second-Floor Plan are seen the roofs over the yard entrances. They are shown pitching in the directions of the conductors, and the chains which support them are shown at each side of the roof. The roof of the front entrance is also shown, and is dotted to indicate that it is terra cotta.

57. Stair Halls.—The stair halls differ from the halls in the First-Floor Plan in that the stairs are shown in one direction only, as there is no stair to the attic or third floor in these halls. In the place of the stair going up, there is a rail across the end of the well hole. The doors from the stair halls to the corridor have side lights for giving additional light in the corridor.

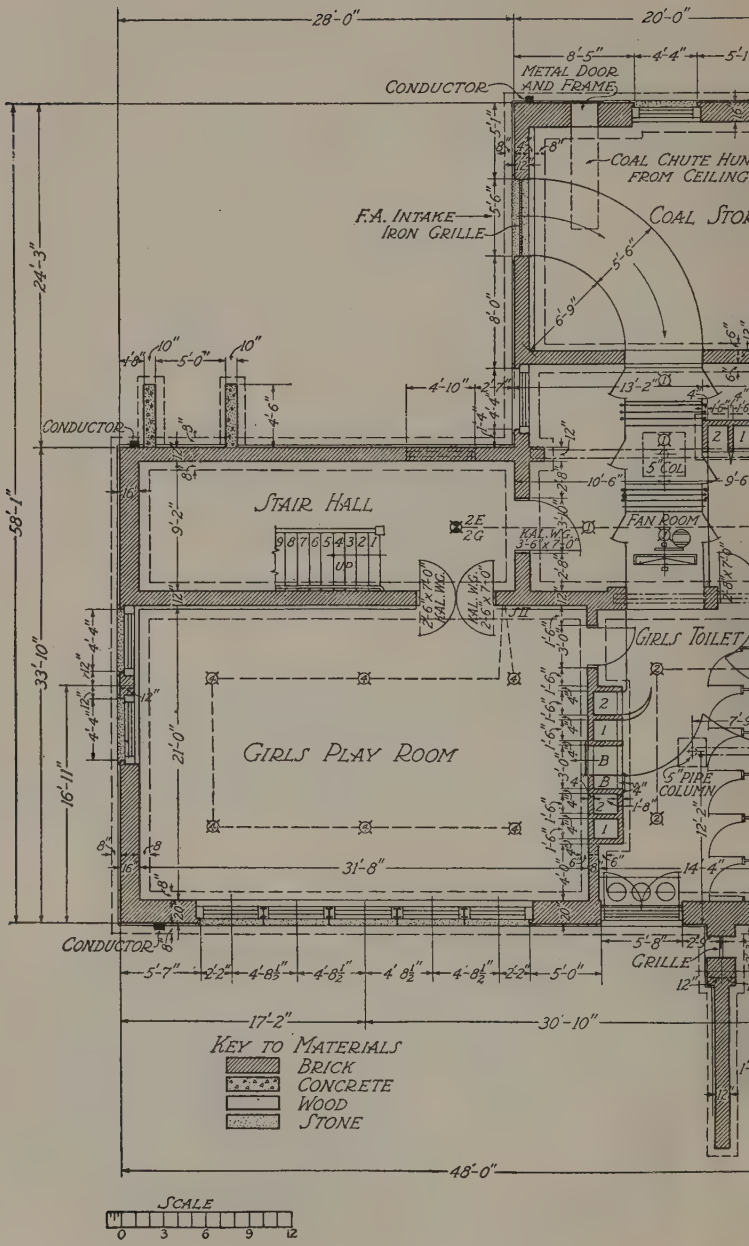
58. Corridor.—The corridor shows double doors opening out from the principal's room. It also shows a stair from the second floor to the attic. As the attic is used only for storage, the stairs need not be so wide as ordinary stairs where there is frequent travel.

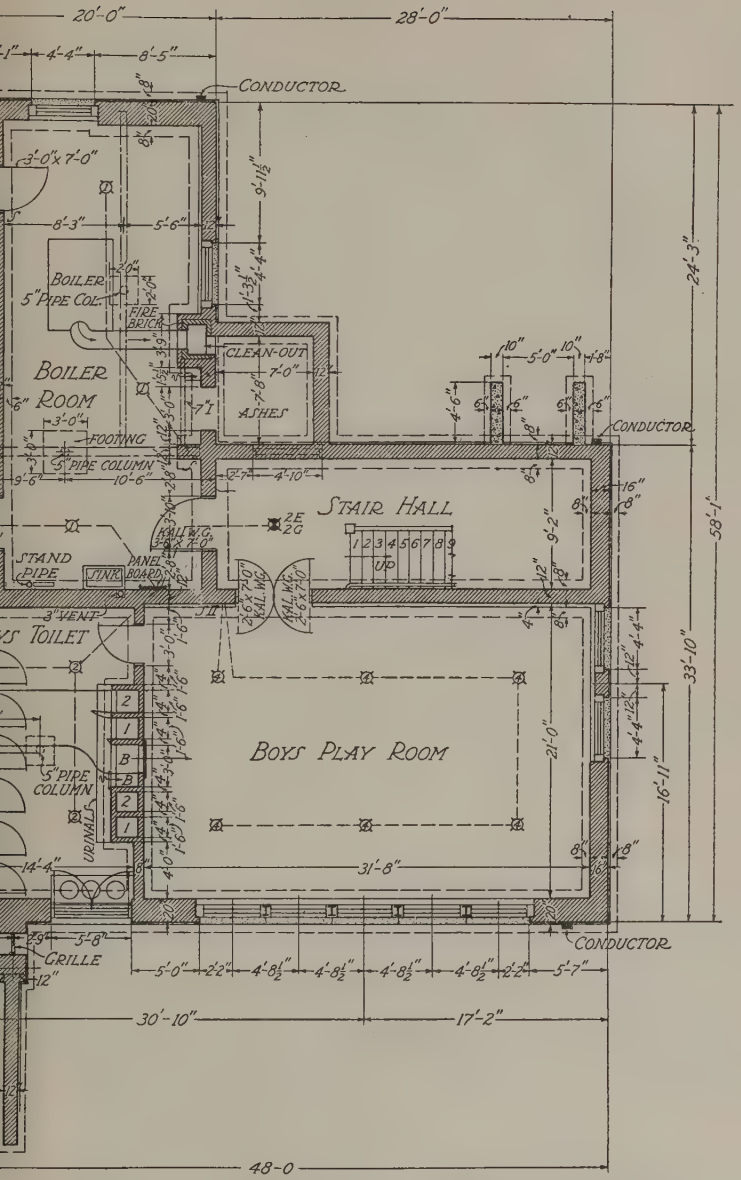
59. Dimensions.—As most of the walls and partitions are carried up straight from the basement and the first floor, there are few dimensions needed, and these are similar to those on the First-Floor Plan. The outside dimensions for windows and walls are all given, as well as certain inside dimensions that will fix the location of the various parts.

BASEMENT PLAN

60. General Explanation.—The basement is reached by means of the stair halls in each end of the building. The stair hall at the right opens into the boys' play room and into the boiler room. The stair hall at the left opens into the girls' play room and into the fan room. From the play rooms, doors open into the toilet rooms, and from the boiler room a door gives access to the coal storage.

This plan shows not only the arrangement of the basement rooms, walls, windows, and other parts, but it also shows, by


28'-0"
20'-0"
CONDUCTOR
METAL DOOR AND FRAME
COAL CHUTE HUN FROM CEILING
F.A. INTAKE IRON GRILLE
COAL STOR
5'-6"
6'-9"
8'-0"
24'-3"
58'-1"
33'-10"
16'-11"
21'-0"
10"
5'-0"
4'-10"
13'-2"
CONDUCTOR
STAIR HALL
9'-2"
2E
2G
KAL. WG. 3'-6"x7'-0"
UP
FAN ROOM
10'-6"
5" COL.
KAL. WG. 2'-6"x7'-0"
KAL. MC.
GIRLS TOILET
GIRLS PLAY ROOM
5" PIPE COLUMN
31'-8"
14'-4"
CONDUCTOR
5'-8"
GRILLE
5'-7"
2'-2"
4'-8½"
4'-8½"
4'-8½"
4'-8½"
2'-2"
5'-0"
17'-2"
30'-10"
KEY TO MATERIALS
BRICK
CONCRETE
WOOD
STONE
48'-0"
SCALE
0 3 6 9 12



BASEMENT - FLOOR - PLAN

broken lines, the footings and foundations under the walls and other parts.

61. Walls and Footings.—As this plan will be used for laying out the building, it is dimensioned fully. The thicknesses of the walls are given in several places, and the sections indicate that brick is the material used. By referring however to the sections shown with the elevations, it will be noted that the brick in the outside walls begins at the bottom of the water-table, concrete being used below the water-table. The walls, however, are of the same thickness for both materials. The inside walls, or partitions, are brick down to the footings, which are about 4 inches below the finished floor line. The walls are calculated for using a standard brick which is about $3\frac{3}{4}$ inches wide, the brick being laid with a $\frac{1}{4}$-inch mortar joint. The wall thicknesses are therefore given as multiples of 4 inches, such as 8-, 12-, 16-, and 20-inch. Should a larger brick be used, these dimensions would be increased.

The walls that support the front-entrance steps are shown to be 12-inch for the walls carrying the cheeks, and 8-inch for the walls which carry the middle portions of the steps. Piers 2 feet by 2 feet are shown for the support of the columns that carry the front porch. There are openings in these walls for access to the space beneath the steps, and these openings are covered by iron grilles that permit a circulation of air for ventilation.

Foundation walls for the play ground entrances are shown to be 10 inches thick, and made of concrete.

Footings for all the walls are shown by broken lines inside and outside of the walls. Footings are also shown under the stacks that contain the heating and ventilating flues from the fan to the various rooms, as well as under the pipe columns. The width of the footings outside the walls they support are indicated at several places, while the sizes of the footings under the columns are also given.

62. Stair Halls.—The First-Floor Plan shows two fireproof stair halls leading down to the basement. On the Basement-Floor Plan may be seen the lower ends of these stairs,

broken off to show that the remainder of the stair is shown on another drawing. The risers are numbered, and arrows indicate the direction in which the travel leads to the floor above. These stair halls are contained between the same walls as on the first and second floors, and consequently are practically the same size.

From the stair hall at the right a single kalamine, or metal-covered, 3′ 6″×7′ 0″ door with a wire-glass panel leads to the boiler room. A pair of double-acting doors, each 2′ 6″×7′ 0″ with wire-glass panels, lead to the boys' play room.

From the stair hall at the left, a single 3′ 6″×7′ 0″ door leads to the fan room. This door also has a wire-glass panel, as indicated by the letters *W. G.* A pair of double-acting doors open from this hall to the girls' play room. These doors also have wire-glass panels.

Both of these halls are lighted by casement windows, which are placed high in the wall so as to be above the ground level, as the basement floor is below the ground level. Ceiling outlets, each provided for two electric and two gas lights are shown in the halls.

63. Play Rooms.—There are two play rooms shown in the Basement Floor Plan. The one on the right is for the boys and the one on the left is for the girls. These rooms are directly below the class rooms No. 1 and No. 2. Double-hung windows are shown in the fronts of these rooms, similar in width to the windows over them in the first and second floors. The construction of these windows is seen in the section at the left of the Side Elevation. Windows are shown in the end walls, the width of the brick opening being shown on the plans. A brick mullion 2 feet wide separates the pairs of windows.

Each play room is lighted by six electric ceiling outlets, with four lights in each. These are on two circuits, as indicated by the broken lines connecting the outlets with the switches just inside the doors.

Each play room may be heated by hot-air registers in the duct stacks as indicated. These registers will be closed when

the play rooms are not in use, and so will not take the heat from the class rooms during the hours that the class rooms are occupied. Each play room has a register to the same vent flue that takes care of the adjoining toilet room.

64. Toilet Rooms.—The girls' toilet room, which is entered from the girls' play room, has indications of six high-tank water closets, a slop sink, and three lavatories. The water closet stalls are enclosed with slate partitions and with doors opening out. A casement window opening in is located over the lavatories, and the room is lighted by two ceiling outlets. These lights are controlled from the switchboard in the boiler room, as indicated by the light lines leading to the board.

In the boys' toilet room, entered from the boys' play room, are a slop sink, three lavatories, six high-tank water closets, and a set of urinals. The type or style of these fixtures would be described in the specifications.

Each toilet room is heated from a register in the duct supplying the stacks leading to the class rooms. The toilet rooms are ventilated by registers to the stacks indicated by the wavy arrows.

65. Boiler Room.—In the boiler room, a boiler is indicated by a rectangle the approximate size of the boiler required, with the word *Boiler* on it. One end of the boiler is connected with the chimney by a curved smoke pipe, the arrows indicating the direction in which the smoke travels. At the side of the boiler is a circle representing a 5-inch pipe column on a footing 2′ 0″×2′ 0″. This column carries a steel girder, indicated by dot-and-dash lines. This girder is directly under a partition in the first and second floors. Under the wall of the corridor is an indication of a 5-inch pipe column on a 3′ 0″×3′ 0″ footing. This column helps to carry a steel girder on which the partition walls in the first and second floors are carried. In the boiler room is seen an indication of a standpipe and hose rack. There is also an indication of a sink and a switchboard or panel board which controls the lights on this floor. The circuits are indicated by broken lines.

Near the boiler is the chimney, which is lined with firebrick. An ash-pit is located just outside the building, in which cans of ashes can be stored until the ashes are carted away. A clean-out door is shown in the base of the chimney.

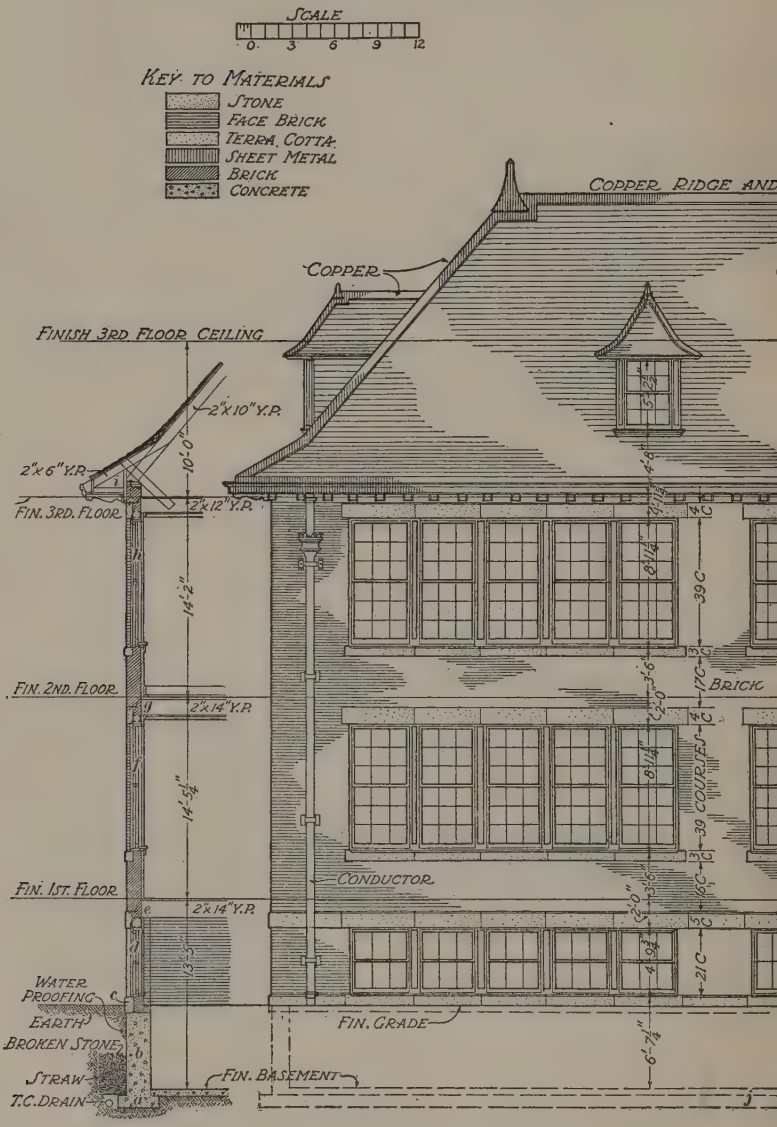
Doors are shown connecting the boiler room with the stair hall, the coal storage, and the fan room.

66. Coal Storage.—The space for coal storage is entered by a door from the boiler room. Coal is placed in the coal storage through a coal chute as indicated. The room is lighted by double-hung windows, and by a drop light near the door.

In the side wall of the coal storage is shown an indication of an opening covered by an iron grille. This is for the purpose of supplying fresh air to the heating apparatus through a duct. The duct is close to the ceiling and is curved as shown by thin solid lines. The arrows show the direction of the air-current.

67. Fan Room.—The fan room contains the apparatus for heating the air for the building, and a fan for forcing the air through the ducts. The fan also draws the air into the fan room through the fresh-air intake. An electric motor is shown which operates the fan. These indications are sufficient to show the contractor where the apparatus will be located, and the general nature of the apparatus required. Plans for the heating and ventilating plant will be prepared separately, either by the contractor doing that work, or by an engineer especially trained in heating and ventilating work. The work of installing the heating and ventilating apparatus is also done by a contractor making a specialty of this work. This contractor generally prepares his own plans. The architect must, however, understand these plans sufficiently well to provide space for the necessary ducts and flues, also for holes in the walls through which the ducts pass.

FRONT - ELEVATION



I L T 448 §7


Building SCHOOLHOUSE
Location CLAYTON, N.Y.
Owner TOWN OF CLAYTON
Job No. 21 Drawing No:
Scale 1/4" = 1'-0" Date June 10/19
Drawn By F.R. Traced By E.H.
Checked By C.S.
JAMES A. BROWN, Architect
100 MAIN ST., SCRANTON, PA.
CORNICE
CONDUCTOR
P.G.
P.
C.
ONE STEP
CHEEK

FRONT ELEVATION

68. The Front Elevation shows the various features that appear in the front of the building, such as doors, windows, the porch and the roof. It shows that the wall is composed of brick and the trimmings of cut stone, and that the ornamental canopy, or hood, forming the front porch is of terra cotta. The roof is indicated as slate with the hips and ridges of copper. A cupola for the bell is indicated to be covered with copper. A cornice is shown with brackets, and dormer windows with slate roofs and copper hips, ridges, and finials.

Below the finished grade, the walls and footings are indicated in broken lines.

69. At the left side of the elevation is drawn a section through the front wall which shows the relation between the elevation and the story heights. This section is taken at a point where it will give the most information about the construction of the wall. Thus, at *a* is shown a section through the concrete footings of the wall. At *b* is the concrete foundation wall, at *c* is a section through the window sill of the basement window. These sills form part of the water-table. At *d* is a section through the basement window, and at *e* the window lintel and the method of supporting the floor joists are shown. A section through the first-floor window is shown at *f*, the lintel and floor construction at *g*, a section through the second-floor windows at *h*, and a section through the main cornice at *i*.

This section represents a cut taken through any of the class-room windows shown in the Front Elevation.

70. A line of figures extending vertically through the windows of all floors shows the relation of the floor levels to the window openings. These figures should be calculated so that the tops and bottoms of the window openings and the top and bottom joints of the stone sills and lintels will coincide with the joints of the brickwork. So that there shall be no error in this matter, a line of dimensions in terms of brick courses is sometimes given, as shown at the right-hand side of the window group. In this line the basement window is marked

21 c, or 21 courses in height. Each brick course is considered as $2\frac{3}{4}$ inches, consequently the basement window opening must be $21 \times 2\frac{3}{4}$ in. $= 57\frac{3}{4}$ inches $= 4$ feet $9\frac{3}{4}$ inches. The distance between the window openings of the basement and first-floor windows is $5c + 16c + 3c = 24c$. $24 \times 2\frac{3}{4}$ in. $= 5$ feet 6 inches. The lintel of the basement window is marked *5 c* and is $5 \times 2\frac{3}{4}$ in. $= 13\frac{3}{4}$ inches in height. The sill of the first-story windows is *3 c*, or $3 \times 2\frac{3}{4}$ in. $= 8\frac{1}{4}$ inches high. The first-floor window is *39 c*, or $39 \times 2\frac{3}{4}$ in. $= 8$ feet $11\frac{1}{4}$ inches in height.

71. This will show the method used in obtaining the various dimensions given in the line through the windows. By using these figures the brickwork will lay up in uniform courses, and the sills and lintels will work in perfectly with these courses.

72. In detailing the terra-cotta work around the entrance porch, the same method must be used. The blocks of terra cotta should be made so that they will fit in with the brickwork. The details of the columns and cornice of the porch should be designed with reference to the brick courses. On this small drawing this has not been done but on a larger-scale detail it can readily be accomplished.

73. Main Entrance.—In the middle of the front is seen the main entrance, reached by the flight of stone steps, as already mentioned in connection with the discussion of the First-Floor Plan. The newels are here seen in elevation, and a very good idea can be obtained of the appearance of the door and of the terra-cotta porch columns and trim around the opening. The design of the lantern and the ornamental metal scrolls that support it are clearly indicated. Plate glass is used in the entrance doors as well as in the side lights and transoms. This is indicated by the letters *P. G.* This entrance would be executed from scale drawings and full-size drawings. An example of a working drawing for the terra-cotta work is given in *Reading Architects' Blueprints*, Part 1.

74. Walls and Openings.—The walls of the building are indicated as being constructed of brick with stone trim-

mings. As has been pointed out, these brick are to be laid $2\frac{3}{4}$ inches from center to center of joint. This size should be decided upon before starting to draw the elevation, so that the stonework and the brickwork will work in together. The kind of brick is generally selected from samples of different kinds and is specified to be like the chosen sample. The bond to be used in laying the brick should also be carefully specified, and if it is an unusual or fancy bond, should be shown on a detail.

75. The windows in school buildings are generally placed in groups, and the various state laws require that they shall be in area equal to a certain percentage of the floor area. The heads should be as close to the ceiling as possible. In this case the windows, except two in the basement, are all double-hung, and in the class rooms are arranged with mullions between them. The windows have stone lintels and sills, which are shown on both the elevations and in the sections. It will be noticed that the basement windows in the toilet rooms have casement windows opening in, and each sash contains four lights. The remaining windows in the basement are known as six-light, three lights being placed in each sash.

In the first story the windows are of two sizes. The windows in the wardrobes are narrow twelve-light windows, and the windows in the class rooms are wider, but of the same height, and have eighteen lights. The class-room windows are arranged in sets of five, with mullions between as already mentioned.

In the second story, the windows are the same as in the first story, with the addition of a triple mullion window in the principal's room. These windows are of the same size as those in the class rooms.

In the roof there are seen two dormer windows, in the fronts of which are double-hung sash, each window having twelve lights.

76. Cornice and Roof.—The cornice is shown in the section as well as in the elevation, and is indicated to be of wood. This cornice will be fully detailed, so much attention

need not be given to it here, but enough is shown on the drawing to permit the contractor to make his estimate. At the edge of the roof is shown a gutter built into the cornice. This may be of copper, or of wood lined with copper, or it may be formed of galvanized iron. Goosenecks, connecting the gutter with the conductors are shown at the corners of the building. They are more clearly seen on the Side Elevation. Each gooseneck terminates in an ornamental head at the top of the conductor, and ornamental bands secure the conductor to the building.

A hipped roof is shown over the entire building and it is covered with slate. There is a break in the roof about 6 feet above the eaves, which gives the roof a somewhat bell-shaped appearance. Two dormer windows are shown, with roofs similar to the main roof, and side views of similar dormers are seen at the end of the building.

77. Cupola.—In the center of the ridge is an octagonal cupola, with louvres, or slats, arranged to exhaust the air from the building. This cupola can also be used to hold a bell if required. The ducts shown in the floor plans lead to this cupola, in order that the wind blowing past the cupola may aid the fan in forcing the foul air out of the building. The ridge and the cupola are marked to be made of copper, but may, however, be formed of galvanized iron.

SIDE ELEVATION

78. On the Side Elevation is seen a side view of the front steps and the porch. The design of the railing is indicated rather vaguely, but the scale details which are given later on by the architect should show the design completely. A grille or ornamental iron screen is shown under the porch.

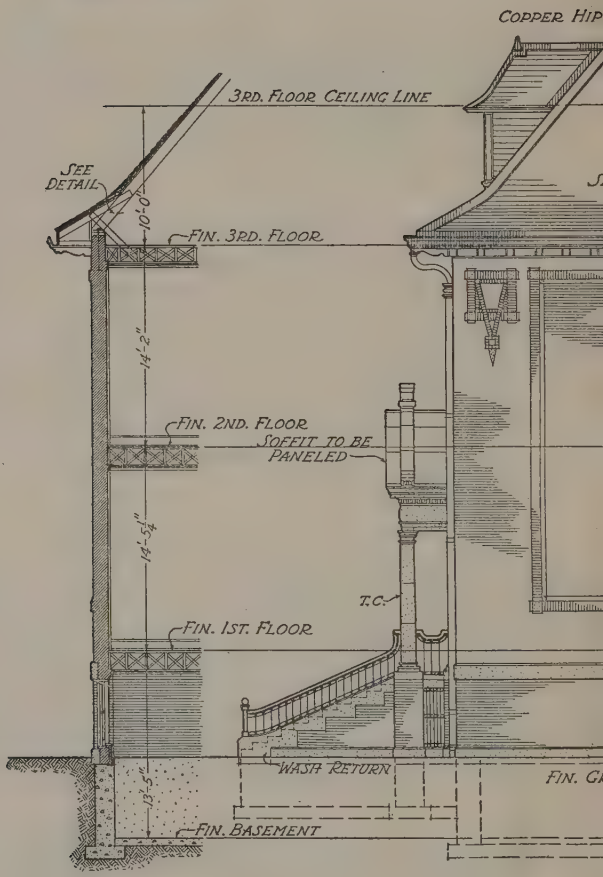
The canopy over the porch is here shown. The footings and foundation walls also are indicated and the depth to which they extend.

79. The outside of the wall of class rooms No. 2 and No. 4 is shown paneled. This effect is obtained by projecting

SIDE - ELEVATION

SCALE
0 3 6 9 12

KEY TO MATERIALS
- STONE
- FACE BRICK
- TERRA COTTA
- SHEET METAL
- BRICK
- CONCRETE



ILT 448 §7


COMPOSITION ROOF FOR DECK
COPPER RIDGE & CUPOLA
SLATE
STONE
CONDUCTOR
METAL CHAIN

slightly a border of stretchers and one of headers as shown. Small blocks of stone are indicated at the corners. Ornamental panels are also shown at each side of the large panel. These are formed by projecting bands of brick and pieces of stone or colored tile.

80. An elevation of the rear wing is shown on the right side of this elevation. It contains a window to the boiler room and windows to the wardrobes of two of the class rooms.

The chimney, which is shown projecting above the roof, is carried above the top of the roof so as to assure a proper draft. Back of the chimney where it leaves the roof is shown a cricket, which directs snow and rain past the chimney. The cricket is covered with sheet metal and is flashed up underneath the slate.

The remaining indications will be clear. They should, however, be studied in connection with the plans until all the indications are thoroughly understood.

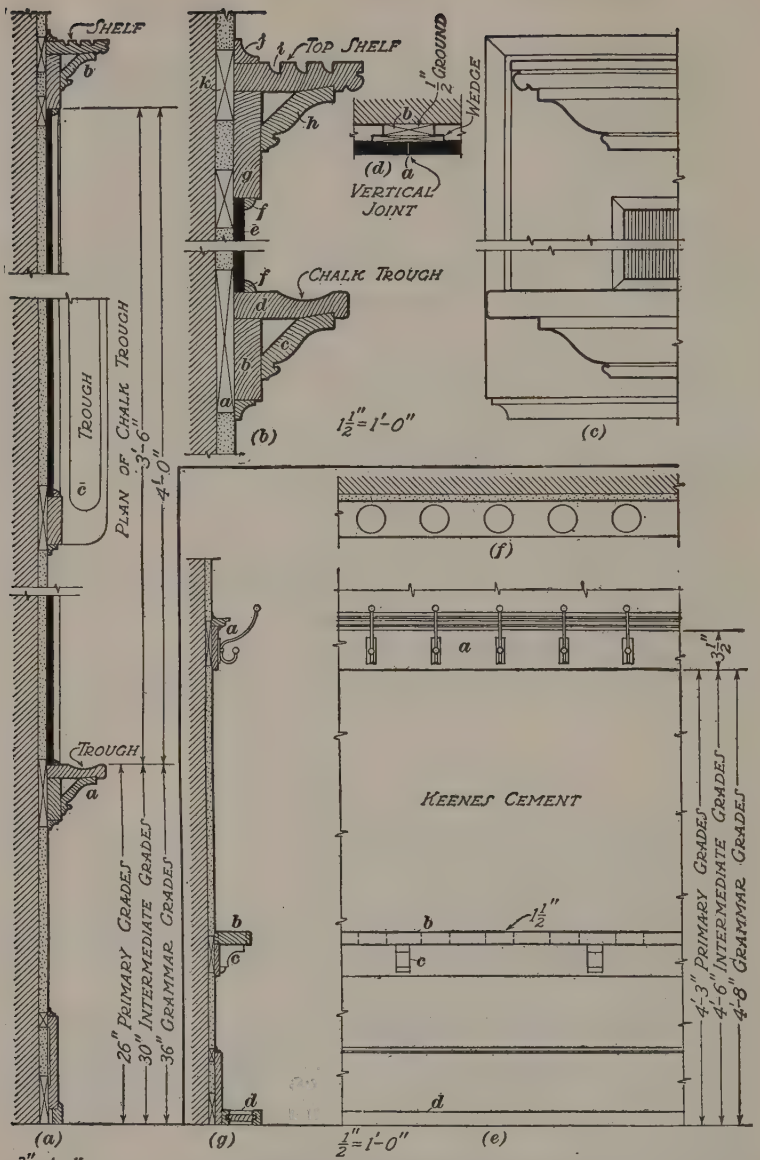
81. At the left of the elevation is given a section to show the story heights and the general construction of the paneled wall.

INTERIOR DETAILS

82. Blackboards and wardrobes are special features of schoolhouses, therefore a sheet of details showing how such fittings are made is given in Fig. 12. It will be seen that the manner of representation is similar to that employed in the drawings that have already been discussed.

83. Detail of a Blackboard.—In Fig. 12 are shown the details of the blackboards of the school building that has been described. The blackboard proper, on which the writing is done, consists of slabs of slate held in a wooden frame in the manner shown.

In (*a*) is shown a section taken vertically through the wall of the class room to which the blackboard is attached. At *a* is a section through the chalk trough or chalk rail, at *b* a section



DETAILS OF BLACKBOARDS, HAT & COAT RACKS, UMBRELLA RACKS & FLOOR TROUGH

FIG. 12

through the cap rail, at *c* a horizontal section through the slate, showing the enclosing frame, and the plan of the chalk trough.

These sections are shown at a much larger scale in (*b*). At *a* are shown grounds, or strips of wood, that are attached to the brick wall. These grounds are spiked to the brick wall and must be made true and secure. To the grounds, the finished wood frame is fastened. The bottom rail on which the slate is supported consists of three strips of molded wood *b*, *c*, and *d*. The strip *d* forms a chalk trough which has a depression in its top surface to contain pieces of chalk.

The slate *e* is placed against the grounds *a* and a molding *f* is nailed to *d* to hold the slate in place. The slate is secured in a similar manner at the top. The strip *g* supports a shelf *i* with a molding *h* under it. The shelf is grooved to prevent drawings or other objects from slipping off it. The molding *j* closes the joint where the shelf meets the wall. The ground *k* affords good nailing for this shelf.

In (*c*) is shown an elevation of one end of the blackboard and its frame showing how it can be finished off in a satisfactory manner.

As the slabs of slate are short, it is necessary to use two or more sheets to form a long blackboard. The sheets are butted together as illustrated in (*d*). Where the sheets come together they are generally rubbed down so that the adjoining surfaces are flush, as at *a*. At such joints, the grounds *b* are made $\frac{1}{2}$ inch in thickness and the plates are adjusted by wedges which are then nailed in place.

84. Details of Wardrobe.—At the bottom of the sheet in Fig. 12 are shown the details of the fittings of a wardrobe such as is attached to each class room. In (*e*) is an elevation of a portion of the wardrobe. In (*f*) is a plan of the umbrella holder, and in (*g*) is a section through the wall of the wardrobe room showing the relation of the various fittings.

In (*e*) at the floor is a trough to take the water that drips from umbrellas. A section through this trough is shown at *d* in (*g*). The umbrellas are held erect by holes in the

shelf *b*. A plan of these holes is shown in (*f*). The shelf is supported by the brackets *c* in (*e*) and (*g*). At *a* in (*e*), and (*g*) is a hat rack with hat hooks. The walls behind these fixtures should be of very hard plaster, such as Keene's cement, and should also be painted with oil paint.

Rubbers may be placed on top of the trough at the floor.

85. Section Through Front Wall.—In Fig. 13 is a detail showing a section taken through the front wall of the schoolhouse. The section is taken through the window of the class room and shows at a larger scale what was shown on the section that appeared on the same sheet as the Front Elevation.

In the upper part of Fig. 13 is a section through the main cornice of the building, showing the construction of the roof and the upper part of the wall. At *a* is a 2″×10″ rafter of yellow pine. The indications show that these rafters are spaced 20 inches, center to center. The foot of the rafter rests on the plate *b*, which consists of two 2-inch planks that are bolted to the wall.

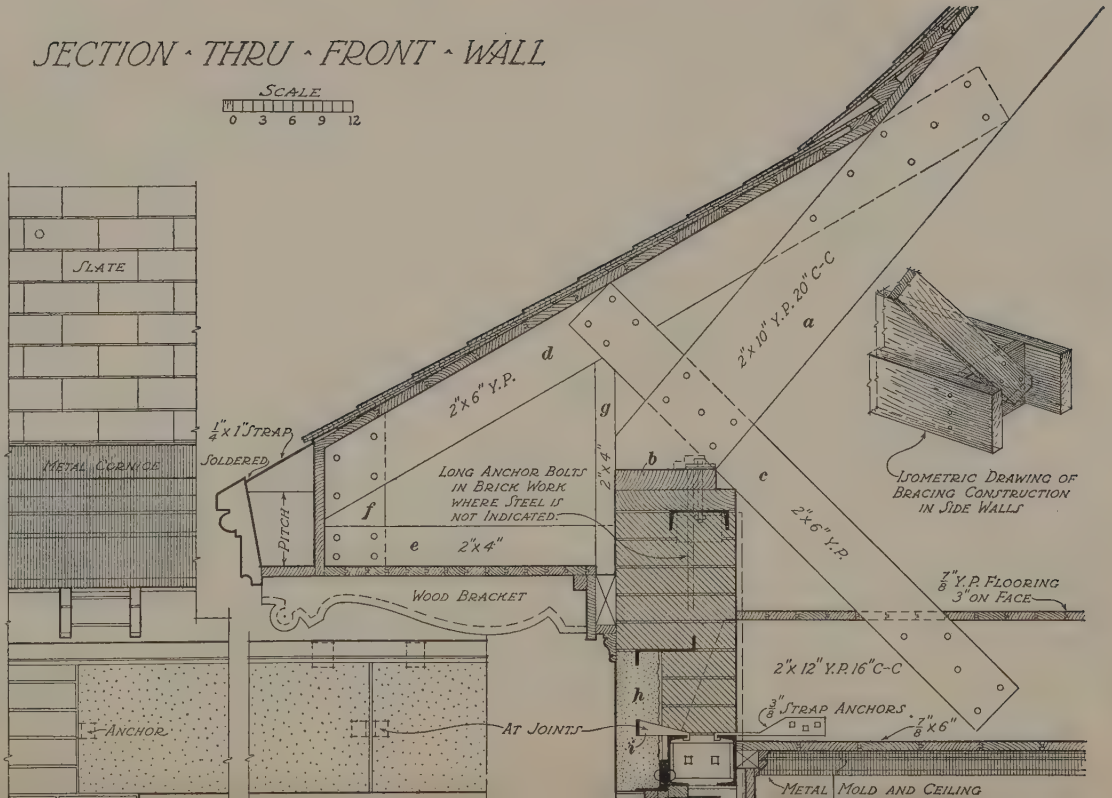
A brace *c* anchors the foot of the rafter to the floor beams.

The cornice is framed by the lookouts *d* and *e*, which are joined by the piece *f*. The lookout *e* is spiked to the side of the piece *g*, which is in turn spiked to the wall. Upon this rough framing the cornice is secured. Matched boarding is nailed on top of *d* to hold the slate, and to the under side of *e* to form a soffit to which the wood brackets are nailed. A metal gutter is secured to the front of this construction and is molded so as to form a cornice.

In the elevation to the left of this section is shown an indication of the sheet-metal gutter and a front elevation of one of the wood brackets.

86. The floor construction of the third, or attic, floor is indicated. The joists are 2″×12″, spaced 16 inches center to center, and of yellow pine. The ends bear upon a steel girder, which is composed of two channels. These ends are shown splayed, having what is known as a fire cut, which in case of fire permits the beam to fall out without destroying

SECTION · THRU · FRONT · WALL



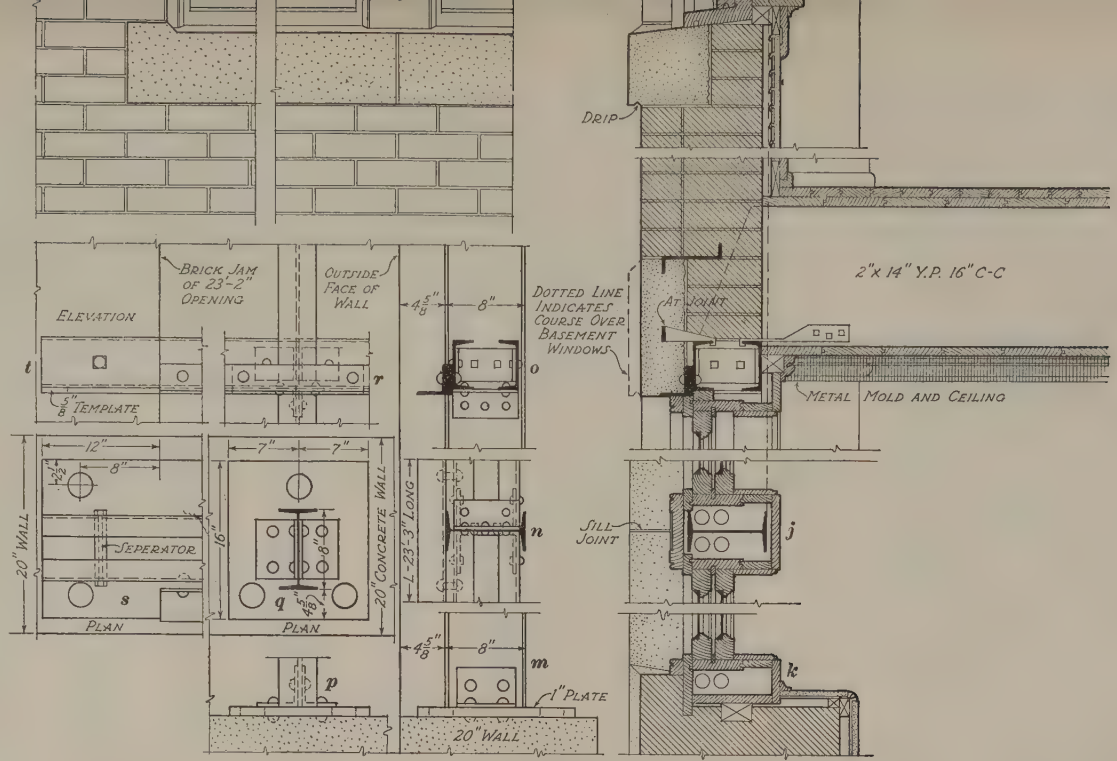

DRIP
2"x 14" Y.P. 16" C-C
DOTTED LINE INDICATES COURSE OVER BASEMENT WINDOWS
AT JOINT
METAL MOLD AND CEILING
SILL JOINT
j
k
BRICK JAM OF 23'-2" OPENING
OUTSIDE FACE OF WALL
ELEVATION
t
r
o
5/8" TEMPLATE
4 5/8"
8"
12"
7"
7"
8"
1/2"
20" WALL
16"
SEPERATOR
s
q
8"
4 5/8"
20" CONCRETE WALL
L-23'-3" LONG
n
PLAN
PLAN
4 5/8"
8"
m
p
1" PLATE
20" WALL

FIG. 13

the wall. A strap anchor which holds the end of the beam to the girder is also shown. One of these anchors is attached to every second or third floor joist, and helps to tie the construction together. A single floor is shown on top of these joists, and a board ceiling covered with a metal ceiling on the under side. A stone lintel *h* is shown resting upon an angle iron that is riveted to the steel lintel and to the columns. The lintel is anchored at the top and at the ends of the stones as shown at *i*. Below the steel lintel is a section through a double-hung window.

87. The construction of the second floor is similar to that of the attic floor, with the exception that two thicknesses of flooring are shown.

At *j* is a plan of a mullion which occurs between the class-room windows. An I beam which supports the weight of the floors and the masonry between the head of the window and sills of the one above, is shown encased in a wooden box which also contains the weights for balancing the sash.

At *k* is a section through the jamb of a class-room window, the elements of which have been already described.

At the left of the sheet is an elevation of part of a window; also part of a mullion *l*.

88. In the lower left-hand corner of the sheet is a detail of the ironwork construction which is used to form the large window openings of the class rooms.

At *m* is an elevation of the base of one of the I-beam columns, which extend up through the mullions of the window groups in the class rooms.

At *n* is a plan of the I-beam column. At *o* is a section through a lintel over the window, as shown in the section through the wall.

At *p* is a view of the base of the I-beam column viewed from the front, at *g* is a plan of the same and at *r* is a front view of part of the lintel shown in *o*.

At *s* is a plan of the lintel as it rests on the wall at the side of the window group, and at *t* is an elevation of the same as viewed from the front.

SPECIFICATION WRITING
(PART 1)

CONTRACT DOCUMENTS

GENERAL DESCRIPTION OF DOCUMENTS

1. Introduction.—When erecting a building by contract, documents and drawings are generally used. The documents are the *contract*, or *agreement*, the *general conditions*, and the *specifications*. The drawings are the working drawings, and such detail drawings as may be required to show clearly the construction of the building. These drawings are also sometimes called *contract documents*.

2. Contract, or Agreement.—The building contract is an agreement to erect a building, or part of a building, or to furnish certain materials for the building for a certain consideration or payment. It is a short document and contains the following features: The date on which the contract is made; the names of the parties between whom the agreement is made; a brief description of the work that is to be done by the contractor; the time in which the contractor is to complete his work; the amount that the owner is to pay the contractor; an agreement as to the documents and drawings to be considered as parts of the contract; a clause binding the successors, executors, administrators, and assigns of the owner and the contractor to perform fully the covenants contained in the contract; the signatures and seals of the parties to the contract and the signatures of the legal witnesses to the signing of the

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contract. The subject of contracts will be treated in a separate Section. The exact nature of a building contract and the way it is considered from a legal point of view will be discussed in that Section.

3. General Conditions.—The general conditions consist of a description of the relations and responsibilities of the owner, architect, and contractor, as well as other important features in connection with the management of the work. The general conditions also contain stipulations regarding insurance, payments, arbitration of differences, cleaning up the premises, and many other matters. A complete set of general conditions is given later in this Section.

4. Specifications.—A specification, used in building operations is a detailed description of the materials, processes, and workmanship required to complete a building or a part of a building. Thus, a specification for the structural steel work of a building is a detailed description of the nature and physical characteristics of the steel to be used, the methods of assembling it and raising it into place, and the labor or workmanship required to produce, erect, and finish the work.

5. Drawings.—The contract refers to the drawings as showing the design of the building to be erected, and they are, therefore, sometimes referred to as contract documents. The drawings present a sort of picture or a series of pictures of the building or parts of the building to be erected. They give the sizes, form, and arrangement of the various parts of the building. This information cannot be given in the other contract documents, as it is shown by means of lines, dots, and symbols peculiar to architectural drawings. In fact, architectural drawing is a special language used to convey ideas of construction and design from one person to another. These ideas cannot be conveyed by the use of words. The drawings are frequently referred to as the *plans*.

Duplicate parts of the specifications are frequently placed on the drawings; this practice should, however, be avoided, as it is apt to be confusing. It is desirable that the drawings and the specifications should fulfil their own proper functions.

6. Relation of Contract Documents.—The four forms of contract documents just described are related to and supplement each other. The contract document states that a certain building or piece of work is to be done for a certain price. The general conditions describe the conditions under which the work is to be done. The specifications describe the materials and workmanship to be used and the drawings show the design and sizes of the various parts of the work.

7. Any item called for in one of the documents must be supplied or built just as though it is mentioned in all. Any item shown in the drawings, but not described in the specifications, must be provided. Anything described in the specifications but omitted from the drawings is just as binding as though it were both shown and described.

GENERAL CONDITIONS

AMERICAN INSTITUTE OF ARCHITECTS' GENERAL CONDITIONS

8. Architects generally differ in their ideas of what should be included in the general conditions. It has been the custom for each architect to prepare a set of conditions that met his own views, and to incorporate them in his specifications. In many cases an architect has them printed so that he can bind the printed copies with his specifications.

9. The American Institute of Architects has devised a set of general conditions which, in its opinion, can be used successfully with any specifications. It advocates the use of these conditions and sells printed copies of them for that purpose. They are printed on paper $8\frac{1}{2}$ inches by 11 inches in size, and can be bound together with specifications written on paper of the same size.

10. These general conditions illustrate very satisfactorily the subjects generally mentioned in such conditions, and will, therefore, be given in full.

11. As a rule, the general conditions are written as though they were a part of the specifications. In many cases they are bound in the same cover with the specifications. In all cases they should be referred to as being binding on the contractor who is estimating from any set of specifications.

GENERAL CONDITIONS OF THE CONTRACT*

Standard Form of the American Institute of Architects

This form has been approved by the National Association of Builders' Exchanges, the National Association of Master Plumbers, and the National Association of Master Steam and Hot-Water Fitters

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3. Details and Instructions.
4. Copies Furnished.
5. Shop Drawings.
6. Drawings on the Work.
7. Ownership of Drawings.
8. Samples.
9. The Architect's Status.
10. The Architect's Decisions.
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42. Assignment.
43. Subcontracts.
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45. Arbitration.

Art. 1. Principles and Definitions.—

(*a*) The Contract Documents consist of the Agreement, the General Conditions of the Contract, the Drawings, and Specifications. These form the Contract.

(*b*) The Owner, the Contractor, and the Architect are those named as such in the Agreement. They are treated throughout the Contract Documents as if each were of the singular number and masculine gender.

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(*c*) The Contractor shall, as in Article **43**, be responsible to the Owner for the acts and omissions of his subcontractors and of all persons directly or indirectly employed by him or them in connection with the work.

(*d*) The term Subcontractor includes only those having a direct contract with the Contractor and it includes one who furnishes material even though he does no work.

(*e*) The term "person" or "anyone" as employed herein shall be taken to include a firm or corporation.

(*f*) Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or mailed to the last business address known to him who gives the notice.

(*g*) The term "work" of the Contractor or Subcontractor includes labor or materials or both.

(*h*) When the words "approved," "satisfactory," "equal to," "proper," "as directed," etc., are used, approval, etc., by the Architect is understood.

(*j*) All time limits stated in the Contract Documents are of the essence of the contract.

(*k*) The law of the place of building shall govern the construction of this contract.

Art. 2. Execution, Correlation, and Intent of Documents.—The Contract Documents shall be signed in duplicate by the Owner and Contractor. In case of failure to sign the General Conditions, Drawings, or Specifications, the Architect shall identify them. Even though the signatures of the Owner and the Contractor may have been attested by witnesses, they may be proved by any competent evidence.

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is to include all labor and materials reasonably necessary for the proper execution of the work. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class or trade of the specifications shall be supplied unless distinctly so noted on the drawings. Materials or work described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards.

Art. 3. Detail Drawings and Instructions.—The Architect shall furnish, with reasonable promptness, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the Contract Documents true developments thereof, and reasonably inferable therefrom. The work

shall be executed in conformity therewith and the Contractor shall do no work without proper drawings and instructions.

The Contractor and the Architect, if either so requests, shall jointly prepare a schedule, subject to change from time to time in accordance with the progress of the work, fixing the latest dates at which the various detail drawings will be required, and the Architect shall furnish them in accordance with that schedule. Under like conditions, a schedule shall be prepared, fixing dates for the submission of shop drawings, for the beginning of manufacture and installation of materials and for the completion of the various parts of the work.

Art. 4. Copies Furnished.—Unless otherwise provided in the Contract Documents the Architect will furnish to the Contractor, free of charge, all copies of drawings and specifications reasonably necessary for the execution of the work.

Art. 5. Shop Drawings.—The Contractor shall submit two copies of all shop or setting drawings and schedules required for the work of the various trades and the Architect shall pass upon them with reasonable promptness. The Contractor shall make any corrections required by the Architect, file with him two corrected copies and furnish such copies as may be needed. The Architect's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

Art. 6. Drawings and Specifications on the Work.—The Contractor shall keep one copy of all drawings and specifications on the work, in good order, available to the Architect and to his representatives.

Art. 7. Ownership of Drawings and Models.—All drawings, specifications and copies thereof furnished by the Architect are his property. They are not to be used on other work and, with the exception of the signed contract set, are to be returned to him on request, at the completion of the work. All models are the property of the Owner.

Art. 8. Samples.—The Contractor shall furnish for approval all samples as directed. The work shall be in strict accordance with approved samples.

Art. 9. The Architect's Status.—The Architect shall have general supervision and direction of the work. He is not the agent of the Owner, except as provided in the contract documents and when in special instances he is authorized by the Owner so to act, and in such instances he shall, upon request, show the Contractor written authority. He has authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the Contract.

In case of the termination of the employment of the Architect, the Owner shall appoint a capable and reputable Architect, whose status under the contract shall be that of the former Architect.

Art. 10. The Architect's Decisions.—The Architect shall, within a reasonable time, make decisions on all claims of the Owner or Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

Except as may be otherwise expressly provided in or appended to these General Conditions or as particularly set forth in the specifications, all the Architect's decisions are subject to arbitration.

Art. 11. Foreman, Supervision.—The Contractor shall keep on the work a competent general foreman and any necessary assistants, all satisfactory to the Architect. The general foreman shall not be changed except with the consent of the Architect. The foreman shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. On written request such directions shall be confirmed in writing to the Contractor.

The Contractor shall give efficient supervision to the work, using his best skill and attention. He shall carefully study and compare all drawings, specifications and other instructions and shall at once report to the Architect any error, inconsistency, or omission which he may discover.

Art. 12. Materials, Labor, Appliances.—Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, and power necessary for the execution of the work.

Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of good quality. The contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall not employ on the work any unfit person or anyone not skilled in the work assigned to him.

Art. 13. Inspection of Work.—The Owner, the Architect and their representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

If the specifications, the Architect's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for inspection and the Architect shall promptly inspect it. If any such work should be covered up without approval or consent, it must, if required by the Architect, be uncovered for examination at the Contractor's expense.

Re-examination of questioned work may be ordered by the Architect and, if found not in accordance with the Contract, all expense of re-examination and replacement shall be borne by the Contractor, otherwise it shall be allowed as extra work.

Art. 14. Correction of Work Before Final Payment.—The Contractor shall promptly remove from the premises all materials, whether worked or unworked, and take down and remove all portions of the work condemned by the Architect as failing to conform to the Contract; and the Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

If the Contractor does not remove such condemned work and materials within a reasonable time, fixed by written notice, the Owner may remove them and may store the material at the expense of the Contractor. If the Contractor does not pay the expense of such removal within five days thereafter, the Owner may, upon ten days' written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

Art. 15. Deductions for Uncorrected Work.—If the Architect deems it inexpedient to correct work injured or not done in accordance with the Contract, the difference in value together with a fair allowance for damage shall be deducted, if acceptable to the Owner.

Art. 16. Correction of Work After Final Payment.—Neither the final certificate nor payment nor any provision in the Contract Documents shall relieve the Contractor of responsibility for negligence or faulty materials or workmanship within the extent and period provided by law and upon written notice he shall remedy any defects due thereto and pay for any damage to other work resulting therefrom. All questions arising under this Article shall be decided under Articles **10** and **45.**

Art. 17. Protection of Work and Property.—The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury arising in connection with this Contract. He shall make good any such damage or injury, except such as may be directly due to errors in the contract documents.

Art. 18. Emergencies.—In an emergency affecting the safety of life or of the structure or of adjoining property, not considered by the Contractor as within the provisions of Article **17,** then the Contractor, without special instruction or authorization from the Architect or Owner, is hereby permitted to act, at his discretion, to prevent such threatened loss or injury and he shall so act, without appeal, if so instructed or authorized. Any compesation claimed to be due to him therefor shall be determined under Articles **10** and **45** regardless of the limitations in Article **25** and in the second paragraph in Article **24.**

Art. 19. Damage to Persons.—In addition to the liability imposed by law upon the Contractor on account of bodily injury or death suffered through the Contractor's negligence, which liability is not impaired or otherwise affected hereby, the Contractor hereby assumes, in cases not embraced within such legal liability, the obligation to save the owner harmless and indemnify him from every expense, liability or payment (voluntary payments excepted), by reason of any injury to any person or persons, including death, suffered through any act or omission of the Contractor or any Subcontractor, or anyone directly or indirectly employed by either of them, in the prosecution of any work included in this contract.

Art. 20. Liability Insurance.—The Contractor shall maintain such insurance as will protect him from claims under workmen's compensation acts and from any other claims for damages for personal injury, including death, which may arise from operations under this contract. Certificates of such insurance shall be filed with the Owner, if he so require, and shall be subject to his approval for adequacy of protection. The Owner shall be responsible for his own contingent liability.

Art. 21. Fire Insurance.—The Owner shall effect and maintain fire insurance upon the entire structure on which the work of this contract is to be done and upon all materials, tools and appliances in or adjacent thereto and intended for use thereon, to at least eighty per cent. of the insurable value thereof. The loss, if any, is to be made adjustable with and payable to the Owner as Trustee for whom it may concern.

All policies shall be open to inspection by the Contractor. If the Owner fails to show them on request of if he fails to effect or maintain insurance as above, the Contractor may insure his own interest and charge the cost thereof to the Owner. If the Contractor is damaged by failure of the Owner to maintain such insurance, he may recover under Art. **39.**

If required in writing by any party in interest, the Owner as Trustee shall, upon the occurrence of loss, give bond for the proper performance of his duties. He shall deposit any money received from insurance in an account separate from all his other funds and he shall distribute it in accordance with such agreement as the parties in interest may reach, or under an award of arbitrators appointed, one by the Owner, another by joint action of the other parties in interest, all other procedure being in accordance with Art. **45.** If after loss no special agreement is made, replacement of injured work shall be ordered under Art. **24.**

The Trustee shall have power to adjust and settle any loss with the insurers unless one of the contractors interested shall object in writing within three working days of the occurrence of loss and thereupon arbitrators shall be chosen as above. The Trustee shall in that case make settlement with the insurers in accordance with the directions of such arbitrators, who shall also, if distribution by arbitration is required, direct such distribution.

Art. 22. Guaranty Bonds.—The Owner shall have the right to require the Contractor to give bond covering the faithful performance of the contract and the payment of all obligations arising thereunder, in such form as the Owner may prescribe and with such sureties as he may approve. If such bond is required by instructions given previous to the receipt of bids, the premium shall be paid by the Contractor; if subsequent thereto, it shall be paid by the Owner.

Art. 23. Cash Allowances.—The Contractor shall include in the contract price all allowances named in the Contract Documents and shall cause the work so covered to be done by such contractors and for such sums as the Architect may direct, the contract sum being adjusted in conformity therewith. The Contractor, in making up his bid, shall add such sums for expenses and profit on account of cash allowances, as he deems proper, and no demand for expenses or profit other than those included in the contract sum shall be allowed. The Contractor shall not be required to employ for any such work a Subcontractor against whom he has a reasonable objection.

Art. 24. Changes in the Work.—The owner, without invalidating the contract, may make changes by altering, adding to or deducting from the work, the contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.

Except as provided in Articles **9** and **18**, no change shall be made unless in pursuance of a written order from the Owner signed or countersigned by the Architect and no claim for an addition to the contract sum shall be valid unless so ordered.

The value of any such change shall be determined in one or more of the following ways:

(*a*) By Estimate and Acceptance in a lump sum.
(*b*) By Unit Prices named in the contract or subsequently agreed upon.
(*c*) By Cost and Percentage or by Cost and a fixed fee.
(*d*) If none of the above methods is agreed upon, the Contractor, provided he receive an order in writing signed by the Owner and countersigned by the Architect, shall proceed with the work, no appeal to arbitration being allowed from such order to proceed.

In cases (*c*) and (*d*), the Contractor shall keep and present in such form as the Architect may direct, a correct account of the net cost of labor and materials, together with vouchers. In any case, the Architect shall certify to the amount, including a reasonable profit, due to the Contractor. Pending final determination of value, payments on account of changes shall be made on the Architect's certificate.

Art. 25. Claims for Extras.—If the Contractor claims that any instructions, by drawings or otherwise, involve extra cost under this contract,

he shall give the Architect written notice thereof before proceeding to execute the work and, in any event, within two weeks of receiving such instructions, and the procedure shall then be as provided in the last paragraph of Art. **24.** No such claim shall be valid unless so made.

Art. 26. Applications for Payments.—The Contractor shall submit to the Architect an application for each payment and, if required, receipts or other vouchers from Subcontractors showing his payments to them for materials and labor as required by Article **44.**

If payments are made on valuation of work done, such application shall be submitted at least ten days before each payment falls due. If required, the Contractor shall before the first application submit to the Architect a schedule of values of the various parts of the work, aggregating the total sum of the contract, divided so as to facilitate payments to subcontractors in accordance with Article **44** (*e*) made out in such form as the Architect may direct and, if required, supported by evidence as to its correctness. This schedule, when approved by the Architect, shall be used as a basis for certificates of payment, unless it be found to be in error. In applying for payments, the Contractor shall submit a statement based upon this schedule and, if required, itemized in such form as the Architect may direct, showing his right to the payment claimed.

Art. 27. Certificates and Payments.—If the Contractor has made application as above, the Architect shall, not later than the date when each payment falls due, issue to the Contractor a certificate for such amount as he decides to be properly due.

No certificate issued nor payment made to the Contractor, nor partial or entire use or occupancy of the work by the Owner shall be an acceptance of any work or materials not in accordance with this contract. The making and acceptance of the final payment shall constitute a waiver of all claims by the Owner, otherwise than under Articles **16** and **29** of these conditions or under requirement of the specifications, and of all claims by the Contractor, except those previously made and still unsettled.

Should the Owner fail to pay the sum named in any certificate of the Architect or in any award by arbitration, upon demand when due, the Contractor shall receive, in addition to the sum named in the certificate, interest thereon at the legal rate in force at the place of building.

Art. 28. Payments Withheld.—The Architect may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any certificate for payment to protect the Owner from loss on account of:

(*a*) Defective work not remedied.

(*b*) Claims filed or reasonable evidence indicating probable filing of claims.

(*c*) Failure of the Contractor to make payments properly to subcontractors or for material or labor.

(*d*) A reasonable doubt that the contract can be completed for the balance then unpaid.

When all the above grounds are removed certificates shall at once be issued for amounts withheld because of them.

Art. 29. Liens.—Neither the final payment nor any part of the retained percentage shall become due until the Contractor, if required, shall deliver to the Owner a complete release of all liens arising out of this contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that the release and receipts include all the labor and material for which a lien might be filed; but the Contractor may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Owner, to indemnify him against any claim by lien or otherwise. If any lien or claim remain unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien or claim, including all costs and a reasonable attorney's fee.

Art. 30. Permits and Regulations.—The Contractor shall obtain and pay for all permits and licenses, but not permanent easements, and shall give all notices, pay all fees, and comply with all laws, ordinances, rules and regulations bearing on the work. If the drawings and specifications are at variance therewith, the Contractor shall notify the Architect in writing before the work is performed and the value of any necessary changes shall be adjusted under Art. **24.** If any of the Contractor's work shall be done contrary to such laws, ordinances, rules, and regulations, without such notice, he shall bear all costs arising therefrom.

Art. 31. Royalties and Patents.—The Contractor shall pay all royalties and license fees and shall defend all suits or claims whatsoever for infringement of any patent rights and shall save the Owner harmless from loss on account thereof.

Art. 32. Use of Premises.—The Contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Architect and shall not encumber the premises with his materials.

The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

The Contractor shall enforce the Architect's instructions regarding signs, advertisements, fires and smoking.

Art. 33. Cleaning Up.—The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his employes or work and at the completion of the work he shall remove all his rubbish from and about the building and all his tools, scaffolding and surplus materials, and shall leave his work clean and ready for use. In case of dispute the Owner may remove the rubbish and charge the cost to the several contractors as the Architect shall determine to be just.

Art. 34. Cutting, Patching, and Digging.—The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon, or reasonably implied by, the Drawings and Specifications for the completed structure and he shall make good after them, as the Architect may direct.

Any cost caused by defective or ill-timed work shall be borne by the party responsible therefor.

The Contractor shall not endanger any work by cutting, digging or otherwise and shall not cut or alter the work of any other contractor, save with the consent of the Architect.

Art. 35. Delays.—If the Contractor is delayed in the completion of the work by any act or neglect of the Owner or the Architect, or of any employe of either, or by any other contractor employed by the Owner, or by changes ordered in the work, or by strikes, lockouts, fire, unavoidable casualties or any causes beyond the Contractor's control, or by delay authorized by the Architect pending arbitration, or by any cause which the Architect shall decide to justify the delay, then the time of completion shall be extended for such reasonable time as the Architect may decide.

No such extension shall be made for delay occurring more than seven days before claim therefor is made in writing to the Architect. In the case of a continuing cause of delay, only one claim is necessary.

If no schedule is made under Art. **3,** no claim for delay shall be allowed on account of failure to furnish drawings until two weeks after demand for such drawings and not then unless such claim be reasonable.

Art. 36. Owner's Right to Do Work.—If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this contract, the Owner, after three days' written notice to the Contractor, may, without prejudice to any other remedy he may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor; provided, however, that the Architect shall approve both such action and the amount charged to the Contractor.

Art. 37. Owner's Right to Terminate Contract.—If the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should, except in cases recited in Art. **35,** persistently or repeatedly refuse or fail to supply enough properly skilled workmen or proper materials, or if he should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Architect, or otherwise be guilty of a substantial violation of any provision of the contract, then the Owner, upon the certificate of the Architect that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor seven days' written notice, terminate the

employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation to the Architect for his additional services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Architect.

Art. 38. Contractor's Right to Stop Work or Terminate Contract.—If the work should be stopped under an order of any court, for a period of three months, through no act or fault of the Contractor or of any one employed by him, or if the Owner should fail to pay to the Contractor, within seven days of its maturity and presentation, any sum certified by the Architect or awarded by arbitrators, then the Contractor may, upon three days' written notice to the Owner and the Architect, stop work or terminate this contract and recover from the Owner payment for all work executed and any loss sustained upon any plant or material and reasonable profit and damages.

Art. 39. Damages.—If either party to this contract should suffer damage by delay or otherwise, except as provided in Art. **40,** because of any act or neglect of the other party or of any one employed by him, then he shall be reimbursed by the other party for such damage.

Claims under this clause shall be made in writing to the party liable within a reasonable time of the first observance of such damage and not later than the time of final payment, except in case of claims under Art. **16,** and shall be adjusted by agreement or arbitration.

Art. 40. Mutual Responsibility of Contractors.—Should the Contractor (see Art. **1** (*c*)) cause damage to any other person (see Art. **1** (*e*)) employed on the work, the Contractor agrees, upon due notice, to settle with such person by agreement or arbitration, if such person will so settle. If such person sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor, who shall, at his own expense, defend such proceedings and, if any judgment against the Owner arise therefrom, the Contractor shall pay or satisfy it and pay all costs incurred by the Owner.

The Contractor, if damaged by any person held to the Owner by stipulations such as the above, agrees to settle with such person by agreement or arbitration and in no case to sue the Owner on account of such damage.

Art. 41. Separate Contracts.—The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford

other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.

If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Architect any defects in such work that render it unsuitable for such proper execution and results. His failure so to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of his work, except as to defects which may develop in the other contractor's work after the execution of his work.

To insure the proper execution of his subsequent work the Contractor shall measure work already in place and shall at once report to the Architect any discrepancy between the executed work and the drawings.

Art. 42. Assignment.—Neither party to the Contract shall assign the contract without the written consent of the other, nor shall the Contractor assign any moneys due or to become due to him hereunder, without the previous written consent of the Owner.

Art. 43. Subcontracts.—The Contractor shall notify the Architect in writing of the names of subcontractors proposed for the principal parts of the work and for such others as the Architect may direct and shall not employ any that the Architect may within a reasonable time object to as incompetent or unfit.

The Contractor may in his discretion or shall, if so required, submit with his proposal, a list of subcontractors. If the change of any name on such list is required or permitted after signature of agreement, the contract price shall be increased or diminished by the difference between the two bids.

The Architect shall, on request, furnish to any subcontractor, wherever practicable, evidence of the amounts certified to on his account.

The Contractor agrees to be fully responsible to the Owner for the acts or omissions of his subcontractors and of anyone employed either directly or indirectly by him or them and this contractual obligation shall be in addition to the liability imposed by law upon the Contractor for bodily injuries or death through negligence in the cases covered by Art. **19** hereof.

Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the Owner.

Art. 44. Relations of Contractor and Subcontractor.—The Contractor agrees to bind every subcontractor and every subcontractor agrees to be bound, by the terms of the General Conditions, Drawings, and Specifications, as far as applicable to his work, including the following provisions of this Article, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the Owner or Architect.

The Subcontractor agrees—

(*a*) To be bound to the Contractor by the terms of the General Conditions, Drawings and Specifications and to assume toward him all the obligations and responsibilities that he, by those documents, assumes toward the Owner.

(*b*) To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment under Art. **26** of the General Conditions.

(*c*) To make all claims for extras, for extensions of time and for damages for delays or otherwise, to the Contractor in the manner provided in the General Conditions for like claims by the Contractor upon the Owner, except that the time for making claims for extra cost as under Art. **25** of the General Conditions is one week.

The Contractor agrees—

(*d*) To be bound to the Subcontractor by all the obligations that the Owner assumes to the Contractor under the General Conditions, Drawings, and Specifications, and by all the provisions thereof affording remedies and redress to the Contractor from the Owner.

(*e*) To pay the Subcontractor, upon the issuance of certificates, if issued under the schedule of values described in Art. **26** of the General Conditions, the amount allowed to the Contractor on account of the Subcontractor's work to the extent of the Subcontractor's interest therein.

(*f*) To pay the Subcontractor, upon the issuance of certificates, if issued otherwise than as in (*e*), so that at all times his total payments shall be as large in proportion to the value of the work done by him as the total amount certified to the Contractor is to the value of the work done by him.

(*g*) To pay the Subcontractor to such extent as may be provided by the Contract Documents or the subcontract, if either of these provides for earlier or larger payments than the above.

(*h*) To pay the Subcontractor on demand for his work or materials as far as executed and fixed in place, less the retained percentage, at the time the certificate should issue, even though the Architect fails to issue it for any cause not the fault for the Subcontractor.

(*j*) To pay the Subcontractor a just share of any fire insurance money received by him, the Contractor, under Art. **21** of the General Conditions.

(*k*) To make no demand for liquidated damages or penalty for delay in any sum in excess of such amount as may be specifically named in the subcontract.

(*l*) That no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the

first ten days of the calendar month following that in which the claim originated.

(*m*) To give the Subcontractor an opportunity to be present and to submit evidence in any arbitration involving his rights.

(*n*) To name as arbitrator under Art. **45** of the General Conditions the person nominated by the Subcontractor, if the sole cause of dispute is the work, materials, rights or responsibilities of the Subcontractor; or, if of the Subcontractor and any other subcontractor jointly, to name as such arbitrator the person upon whom they agree.

The Contractor and the Subcontractor agree that—

(*o*) In the matter of arbitration, their rights and obligations and all procedure shall be analogous to those set forth in Art. **45** of the General Conditions.

Nothing in this Article shall create any obligation on the part of the Owner to pay to or to see to the payment of any sums to any Subcontractor.

Art. 45. Arbitration.—Subject to the provisions of Art. **10,** all questions in dispute under this contract shall be submitted to arbitration at the choice of either party to the dispute.

The general procedure shall conform to the laws of the State in which the work lies and wherever permitted by law the decision of the arbitrators may be filed in court to carry it into effect.

The demand for arbitration shall be filed in writing with the Architect, in the case of an appeal from his decision, within ten days of its receipt and in any other case within a reasonable time after cause thereof and in no case later than the time of final payment, except as to questions arising under Article **16.** If the Architect fails to make a decision within a reasonable time, an appeal to arbitration may be taken as if his decision had been rendered against the party appealing.

The parties may agree upon one arbitrator; otherwise there shall be three, one named in writing by each party and the third chosen by these two arbitrators or, if they fail to select a third within ten days he shall be chosen by the presiding officer of the nearest Bar Association. Should the party demanding arbitration fail to name an arbitrator within ten days, of his demand, his right to arbitration shall lapse. Should the other party fail to choose an arbitrator within such ten days, the Architect shall appoint such arbitrator. Should either party refuse or neglect to supply the arbitrators with any papers or information demanded in writing, the arbitrators are empowered by both parties to take ex parte proceedings.

The arbitrators shall act with promptness. The decision of any two shall be binding on all parties to the dispute. The decision of the arbitrators upon any question subject to arbitration under this contract shall be a condition precedent to any right of legal action.

The arbitrators, if they deem that the case demands it, are authorized to award to the party whose contention is sustained such sums as they shall

deem proper for the time, expense and trouble incident to the appeal and, if the appeal was taken without reasonable cause, damages for delay. The arbitrators shall fix their own compensation, unless otherwise provided by agreement and shall assess the costs and charges of the arbitration upon either or both parties.

The award of the arbitrators must be in writing and, if in writing, shall not be open to objection on account of the form of the proceedings or the award.

COMMENTS ON GENERAL CONDITIONS

12. Comments on A. I. A. General Conditions.—Comments on some of the general conditions of the A. I. A. are found hereafter. The articles referred to by number are those in the A. I. A. General Conditions, and not the articles in the textbook. These comments are intended to explain briefly, and, in some cases, to give some of the reasons for, the use of the conditions referred to.

13. Comment on Art. 2: Execution, Correlation, and Intent of Documents.—The article on execution, correlation, and intent of documents establishes the relation of the drawings, general conditions, and the specifications, as parts of the contract. It also points out that these documents are complementary, and that work called for in any one of them is binding. It also provides for routine, customary, or necessary work not particularly specified, but which must nevertheless be done by the contractor. It also provides that the contractor shall include any small items that may have been overlooked by the architect. The architect should strive to make the drawings and specifications so complete, however, that the provisions of this article will not be applied.

14. Comment on Art. 3: Detail Drawings and Instructions.—The detail drawings referred to in the article include all drawings not furnished at the time bids were requested of the contractors, and generally consist of scale and full-size drawings. The architect should have ample notice of the contractor's desire to have these drawings so as not to delay the work. The contractor should never be allowed to do work without these details; for, if work is done in this manner, the

spirit of the design will undoubtedly be destroyed, and if the contractor is not conscientious, inferior work may be substituted. On the other hand, if the architect in making the details is not careful to follow closely the small scale drawings from which the contractor figured, the cost may be increased, in which case the contractor may object and resort to arbitration to determine whether or not the work desired is in accordance with the contract drawings, or reasonably inferable therefrom.

15. Comment on Art. 5: Shop Drawings.—Shop and setting drawings are made by contractors for structural steel, ornamental iron, stone, terra-cotta, and other trades. Before the work to which these drawings relate is executed, they should be examined and approved by the architect, in order to insure that they are correct and that they relate properly to the remainder of the work.

16. Comment on Art. 6: Drawings and Specifications on the Work.—A complete set of the drawings should always be left in the office of the contractor's superintendent, or the clerk of the works, if one is employed. By having the plans thus available, they may when necessary be referred to by the workmen, foremen, architect, and others. A suitable table or shelf should be provided on which the drawings may be laid out.

17. Comment on Art. 7: Ownership of Drawings and Models.—The purpose of the article on Ownership of Drawings and Models is to protect the architect from the possible distribution of certain structural, artistic, or other original ideas embodied in the drawings and specifications, possibly the results of many years of study and experience, and which, in a measure, constitute his stock in trade. In case of any suit, however, between the contractor and the subcontractors or the owner, involving work under the contract, copies of the drawings should be furnished to the contractor at cost, in order that any necessary evidence may be obtained from them.

18. Comment on Art. 8: Samples.—The purpose of the article on Samples is to give the architect a definite standard to

follow, and is applicable to tiling, brickwork, slate, stains for woodwork, etc.

19. Comment on Art. 9: The Architect's Status.—There is a misconception that seems to be quite universally held, as to the duty of the architect. Many owners expect, and seem to consider it the duty of an architect employed by them, to look after their interests at the expense of the contractor; whereas, the architect's duty is limited to making the drawings and specifications, and supervising the directing within the authority given him by the contract and the specifications.

20. Comment on Art. 10: The Architect's Decisions. As a rule, the architect knows more about the subject matter of any dispute that may arise between the parties concerned than any outsider, generally gives a fair decision, and charges nothing for the service rendered. If the parties resort to arbitration, or submit their dispute to the courts, considerable expense is entailed and the case is less likely to end satisfactorily to all concerned.

Questions frequently arise as to the intent and meaning of the specifications, the quality of materials, etc. The architect should have the authority to decide them. In all questions where the artistic effect, such as in the execution of wood and stone carving, or the modeling of terra cotta, are concerned, the architect's decisions should always be accepted, unless more work is demanded than is shown on the drawings, or reasonably implied in the specifications. If his decisions are regarded as unfair, the contractor should have recourse to arbitration.

21. Comment on Art. 11: Foreman, Supervision.—The contractor should give the work his personal supervision, both on the building and in the shop. When a contractor of good reputation as a skilful mechanic is selected by the owner or the architect, his skill and experience are depended on, hence the clause requiring the contractor's personal supervision.

The contractor should not change figures or otherwise alter the drawings, but must report to the architect for correction all errors or discrepancies that he may discover. So far as

possible, these changes should be made before going ahead with any work in which errors are involved. If an error should be found in the drawings, or a misstatement found in the specifications, it is well to have the architect make the correction. Sometimes the contractor or other person handling the drawings may discover what is thought to be an error, and should a change be made without consulting the architect, trouble may follow.

22. Comment on Art. 13: Inspection of Work.—The inspection provision is to enable the architect or his superintendent to examine the work at all points necessary, and to inspect the material wherever stored.

23. Comment on Art. 14: Correction of Work Before Final Payment.—The removal of defective material from the site, as soon as possible after its discovery, is important, as some of it may otherwise be built into the building in spite of the superintendent's vigilance.

24. Comment on Art. 16: Correction of Work After Final Payment.—The purpose of the clause having to do with correction of work after final payment is to make it impossible for the contractor to contend successfully that because the certificate was issued, defective work discovered after the final payment has been made has been accepted by the owner. This clause also covers such things as adulterated paint, poor mortar, or any work that at the time of acceptance appeared perfect, but through some defect developed imperfections later. When these are obviously caused by material or workmanship not conforming with the specifications, this clause furnishes redress for the owner.

25. Comment on Art. 17: Protection of Work and Property.—The article protects the owner against suit by reason of injury to persons, damage of adjoining property, stolen tools, and the like, and insures the protection and convenience of the public in passing the premises. In the case of a city building, a temporary sidewalk, roofed over to protect pedestrians from falling materials might be required.

Tradesmen are naturally careless as to finished work, and are liable to pull material through a window and over the sill, thus injuring the sill or the jambs. In carrying timbers, building scaffolds, and work of a like nature, they are liable to strike and damage carved or other finished work. All work in danger of being thus damaged should be carefully protected, and, as this is very frequently neglected, the superintendent should be vigilant in watching for unprotected work, and order the same taken care of. The responsibility for such damage is often difficult to locate, and the only satisfactory arrangement is to make the general contractor responsible. In case the work is under several contractors, and no such clause as the one just quoted is included in the general conditions, it is not a very easy matter to obtain remuneration for such damage, owing to the difficulty of locating the responsibility.

26. Comment on Art. 20: Liability Insurance.—The article on liability insurance is very necessary, as many states have enacted workmen's compensation acts, and large damages may be assessed against the contractor in case of accident. If the contractor is unable to pay the claims, they act as a lien upon the building.

27. Comment on Art. 21: Fire Insurance.—In requiring the owner to maintain the insurance on all the property likely to be damaged by fire, the parties interested are protected according to the interests which they have in the building. Insurance makes it possible for the owner to continue the work in case of a destructive fire, and protects the contractor from a possible termination of the work because of bankruptcy on the part of the owner due to the fire.

28. Comment on Art. 25: Claims for Extras.—There should be no trouble in regard to the cost of extra work if this clause is carried out, and it should be fully explained to the client. During the progress of erection, it is a common occurrence for an owner to visit the building and, without consulting the architect to direct the contractor to make changes. If the contractor carries out the verbal orders, the probabilities are that the owner, at the final settlement, will be much

astonished to learn that the bill of extras is very large, and is sometimes unreasonable enough to blame the architect for the occurrence of extras. The order for extra work is usually made by the architect (after explaining it to the owner) and is indorsed in writing by the owner.

29. Comment on Art. 26: Applications for Payments. It is customary to state in the contract when the payments will be made, and on what the payments will be based. The common method is for the architect, at the first of each month, on the receipt of an estimate from the contractor, to issue a certificate stating that in his opinion the contractor is entitled to a certain sum of money, usually from 80 to 95 per cent. of the estimated value of the work done during the previous month. The certificate is given to the contractor, who presents it to the owner for payment, and the owner retains the receipted certificate. The certificate is merely an expression of opinion on the part of the architect, that a certain amount of money is due the contractor. These certificates can be obtained in book form, from which they are torn when used. Stubs on which the date, the amount, and other information are recorded, are left. The architect may arrive at the amount due the contractor by using the unit prices and quantities mentioned in the latter part of Art. 26 of the General Conditions.

30. When the work is completed, the contractor usually notifies the architect that he is ready for a settlement, so that the architect, owner, or others interested, may make any statements they wish, or submit any bills before the architect issues his final certificate. The statements and bills, referred to are rebates on allowed inferior work, damages, or other claims for deductions on the contract price, extras, and other things of a similar nature.

31. The architect sometimes requires proof from the contractor that all the contractor's bills have been paid, and that no claims for unpaid work or materials will be presented. The method of giving this proof is sometimes stated in the contract.

32. Comment on Art. 30: Permits and Regulations. As all the work on the building must be done in accordance with the existing laws, the article on permits and regulations makes such laws and ordinances a part of the contract. Some architects state specifically that the laws and ordinances must be so considered, the same as if they were expressly written in full in the general conditions or in the specifications. The architect should be very careful to learn exactly what parts of the building and sanitary laws refer to the work in hand, in order to know just what is included in the article mentioned. The contractor is thus required to apply for and to pay for the necessary permits, licenses, etc., that may be required by the law, gas, water, or lighting corporations. In some cases the architect must assist the contractor in the preparation or presentation of the plans. The work usually includes a building permit or official approval of the drawings and specifications by the city building department; a plumbing permit, or approval of the drainage drawings by the city board of health or department having this particular work in charge; and permits for taps to gas, water, and electric-light mains.

33. Comment on Art. 32: Use of Premises.—The article on the use of the premises, in connection with Art. **17,** of the General Conditions, requires that the contractor shall observe the rights of others, as defined by the local regulations regarding building, and so forth. In some cities the contractor is allowed to use a portion of the street for the purpose of unloading or storing material, and this regulation must be carefully observed. The ordinances also sometimes require that floors shall not be loaded over a specified amount to the square foot, and that certain other precautions must be observed.

34. Comment on Art. 33: Cleaning Up.—Contractors very often neglect to keep the premises well cleared of rubbish; frequently, this is detrimental to the work and sometimes delays it.

35. Comment on Art. 43: Subcontracts.—The purpose of the clause on subcontracts is to avoid having irresponsible

subcontractors on the work. If the work is given to such contractors, it is very difficult, if not impossible, to get good results from them. If the architect is well-informed in regard to the various contractors, there should be no trouble in arranging a list of several reliable men from which the general contractor may choose. The responsibility of the general contractor for the work of the subcontractors should be strictly insisted upon, and clearly stated in the specifications; otherwise, the work of the superintendent is likely to be greatly hampered.

ADDITIONAL GENERAL CONDITIONS

36. The general conditions of the A. I. A. are quite complete. Additional conditions, however, are sometimes used by different architects. Some of these conditions will be given at this point, together with brief comments. These conditions may prove useful in writing specifications, as they may be specially applicable in certain cases.

37. A condition sometimes used in regard to the drawings is that "Figured dimensions must be followed in all cases in preference to scale measurements, and drawings and details at a larger scale in preference to those at a smaller scale." The paper or cloth upon which a drawing or blueprint is made is subject to the effects of the weather, and swells and shrinks. A blueprint is washed in water and is apt to shrink noticeably. Slight mistakes in measurements are also often made in drawings. For these reasons measurements by scale made on drawings and prints are not dependable. The figured dimensions are, however, absolute and should be accurate, and may be depended upon. Drawings at a larger scale or size naturally show more of the construction and forms of an object than smaller drawings, and are, therefore, easier to follow.

38. Another condition that is used in connection with drawings is "In case of a discrepancy between the drawings and the specifications, the specifications should be followed."

This condition applies when there is a distinct contradiction between drawings and the specifications.

39. Another condition is as follows: "The contractor is to erect, where directed, a temporary office, for the use of the contractor, architect, and owner, and maintain the same until the work is completed. The office must be 8 by 10 feet in plan, and furnished with heat, light, a chair, a chest of drawers with a flat top 4 by 8 feet in size. The contractor is to install and pay for the use of a telephone for use in connection with the work. A complete set of drawings and specifications must always be kept in this office."

This temporary office is a great convenience to the contractor, foreman, and architect. The telephone puts the owner, architect, and contractor in touch with the building at any time during working hours. The temporary office may also be used by a night watchman if one is employed on the work.

INFORMATION FOR BIDDERS

40. Instructions to those who wish to submit estimates from specifications and plans are often given with the specifications. These instructions are in regard to how the proposals shall be submitted, inspection of site, submitting samples, competency of bidders, and so forth. The instructions cover points that are not covered in the contract, the general conditions, or the specifications. They pertain only to the process of sending in the estimate or bid. After the bid has been accepted, they have no further value. An example of a sheet of instructions to bidders is shown; it is sometimes bound in the specifications immediately following the title page.

INSTRUCTIONS TO BIDDERS

1. Submission of Proposals.—Proposals to be entitled to consideration must be made in accordance with the following instructions:

Proposals shall be enclosed in an opaque, sealed envelope, addressed to the architect, at his office, marked "Proposal" and bearing the title of the work for which the proposal is made, and the name of the bidder.

No oral, telegraphic, or telephonic proposals or modifications will be considered.

2. Additional Information.—In case a bidder finds discrepancies or omissions in the drawings or documents or is in doubt as to the meaning of them, he should at once notify the architect, who will forthwith send a written instruction to all bidders. Neither owner nor architect will be responsible for any oral instructions.

3. Inspection of Sites.—Before submitting a proposal, bidders should carefully examine the drawings and specifications, visit the site of the work, fully inform themselves as to all existing conditions and limitations, and shall include in the proposal a sum to cover the cost of all items contemplated by the drawings and documents.

4. Samples.—Each bidder shall submit, with his proposal, samples of the materials which he proposes to use, whenever so required by the specifications.

5. Competency of Bidders.—The competency and responsibility of bidders and of their proposed sub-contractors will receive careful consideration in the award.

6. Right to Reject.—The owner does not obligate himself to accept the lowest or any other bid, and may waive any informality in any proposal.

SPECIFICATIONS

GENERAL DETAILS

41. Definition.—As already defined, a specification is a detailed description of the materials, processes, and workmanship that are required to complete a building or a portion of a building. A specification may be in the form of a single document containing a description of all the work and materials that are to be included in a building. This frequently occurs when the building is small or unimportant, and when a brief specification will be sufficient. Generally, however, there are two or more specifications written, each covering a part of the entire work. In such cases, separate specifications are written for groups of trades such as the masonry trades, carpentry trades, and so forth. Separate specifications are also written

for electric wiring, plumbing and heating, and this arrangement makes it possible to give to each contractor the specification in which he is interested.

42. Another method is to write separate specifications for each trade. A general contractor may take any number of these separate specifications, and make bids on them. Having the specifications in separate form enables the contractor to hand them to subcontractors who may wish to bid on one or more of the specifications. Each architect has his own methods of handling such matters, and generally adapts his methods of writing specifications to the building or project under consideration.

43. Appearance of Specifications.—The specification may be typewritten, printed, or written. For very large buildings, especially public buildings, the specifications are frequently printed and bound in pamphlet form. Where only a few copies are required, they may be mimeographed or blueprinted from a typewritten copy. If they are to be blueprinted, the original typewritten copy is made on very thin transparent paper, and any number of prints can be made. The various pages forming the complete specification are fastened together and generally enclosed in a paper cover.

44. Title.—The title of the specification appears on the first page or on the cover. It states the nature of the work specified, the character and location of the structure to be erected, the names and addresses of the owner and of the architect.

45. Index.—When the specification is large, it is customary to provide an index of its contents. The index may be placed at the beginning or at the end of the specifications, and may be arranged in any of several ways, depending upon the method of arranging the specifications. In some specifications each article is numbered from the beginning to the end regardless of the subjects treated. In such a case the index may refer to the number of the article without giving the page on which the article occurs. It may also give the page. The articles

may not be numbered, but may be given under various headings and subheadings. The index will then list the headings and refer to the page in the specifications where the corresponding headings will be found.

The index is generally arranged alphabetically. It may be grouped into separate trades, and be arranged alphabetically for each trade. In such a case it consists of a series of indexes for the various trades. Another method is to make one index for all the material in the specifications, instead of dividing it into individual indexes. In this case it is also arranged alphabetically.

46. General Conditions.—The general conditions, when bound with the specifications, are next given. They should appear under the heading General Conditions, and may be indexed with the specifications. The architect may simply purchase sets of the General Conditions, such as those approved by the American Institute of Architects, and insert them in the specifications. Many architects, however, prefer to write their own general conditions, and place them with the specifications. Whatever general conditions are used it is desirable that they be bound together with the specifications. In small contracts most of the general conditions are omitted. When, however, the contract is at all important, it is better to have a set of General Conditions go with the plans and specifications.

47. List of Drawings.—A list of drawings is sometimes given after the General Conditions. This list includes all the working drawings from which the estimates have been made. They consist generally of the elevations, sections, and plans of the building at a scale of $\frac{1}{4}'' = 1'\,0''$, and perhaps certain details of mantels, interior trim, etc., at a larger scale. It is understood, and it is stated in the general conditions, that further detail drawings are to be furnished by the architect as they may be required.

48. Separate Trades.—A specification is generally written for each trade and all the work and material to be mentioned regarding this trade should be mentioned in that

specification. It is not fair to a contractor to ask him to look through several different specifications in order to find all the items that he is to estimate upon or supply.

49. Headings and Subheadings.—The general headings, consisting of the name of the trade or kind of work to be specified, should be placed over the center of the description which follows. Subheadings are generally placed at the side, at the beginning of each statement or article. These subheadings should be numbered to permit of reference in the index.

50. General Conditions Referred To.—When the specifications are bound without including the general conditions, it is a good idea to make the first article refer to the general conditions, and to state that "the general conditions applying to the whole work are to be taken as part of this specification as if printed herewith, except where they obviously do not apply."

51. Scope of Work.—A good article or paragraph to insert at the beginning of the specification of each trade or kind of work is one defining briefly the work that is to be covered by the specifications. For example, in a specification for electric wiring, the following paragraph might be inserted to great advantage:

> Scope of Work.—The object of this specification is to provide a complete wiring system from the Electric Company's service wires to each and every outlet throughout the building, including switches, feeders, distributing panels, cut-out boxes, circuit wiring, local switches, plug receptacles, outlet boxes, etc., all of which is to be done in strict accordance with these specifications.

52. After the two paragraphs referring to the general conditions and to the scope of the work, the specifications of labor and materials follow. The examples of the specifications given later will illustrate the methods used in writing such specifications.

A specification, being part of a contract, and describing all the various parts of a building for which an owner is to pay,

should for two reasons be written very carefully. One reason is that the owner may know precisely what he is to receive for a fixed payment. The other is that the contractor may know exactly what he will be required to furnish for that payment.

KNOWLEDGE REQUIRED TO WRITE SPECIFICATIONS

53. Introduction.—To be a successful specification writer, it is quite obvious that one must possess a complete knowledge of everything that is connected with the construction and finishing of a building; otherwise, a great deal of misunderstanding and trouble may occur during the erection of the building.

54. Knowledge of Drawings.—It is especially necessary to have a thorough knowledge of the drawings and all the indications found on them. Some specification writers pin all the drawings on a wall so that they can be seen readily, to avoid handling them on a table. From the drawings the specification writer should be able to form a mental picture of the building and its various parts.

55. It often happens that the specification writer will suggest changes and improvements in the plans. Changes may be necessary to accommodate the plumbing or heating systems. For this reason it is generally safer to write the specifications from the pencil drawings, which can be altered readily, rather than to wait until the final tracings and blueprints are made.

56. Knowledge of Client's Requirements.—The specification writer should have a complete understanding of the requirements of the client, who in consulting with the architect expresses his preferences and desires regarding many points in connection with the building. All the requirements agreed upon should be carefully included in the specifications.

57. Knowledge of Construction.—A good knowledge of construction is necessary in preparing a specification. Many details of construction are not shown on the drawings, but

are indicated only in a general conventional way. The specification writer must understand thoroughly what is indicated, and should supply in his specifications the information necessary to complete the ideas indicated in the drawings. For example, a brick wall is indicated on a drawing by two lines with hatching between them. The specification writer must describe the bond, the quality, and color of the brick, the size of the joints, the mortar to be used, the ingredients and proportions to be used in the mortar, the finish of the joints, etc. These things are generally not shown in a drawing, but the specification writer, knowing the construction of a wall, will specify all those particulars, and thus supplement the information given on the drawings. Another example is a wash basin, which is shown on a drawing in a conventional manner only. The specification writer must supply virtually all the information regarding the fixture. The name of the manufacturer, the trade-name of the fixture, the material, size, etc. appear only in the specification.

58. Knowledge of Materials.—It is necessary to have a good knowledge of the various building materials that are being introduced from time to time in the market. They are advertised in the various magazines, and clients who read these advertisements expect the architect to be familiar with the articles described. The standard materials used in building should be familiar to the specification writer, and when they may be bought to advantage; how long it will be necessary to wait for deliveries, the durability, applicability, cost, etc., of all building materials should be known by the writer of specifications.

59. Catalogs.—There are many catalogs and advertisements regarding the various materials and devices used in building construction. It will be necessary for a good specification writer to obtain and file such catalogs so that they may be referred to readily. A great amount of necessary information is contained in such catalogs, and no office is complete without a set of catalogs that has been well-selected and systematically filed.

60. Samples.—Of great importance also is a supply of samples of materials and devices that are sent gratis to architects by manufacturers. These samples are very useful in giving exact information regarding the appearance, dimensions, and operation of devices, as well as the color, texture, and appearance of various materials. They are also convenient to show to clients when recommending a given material or device for his building.

61. Knowledge of Trade Customs.—It is very desirable to have a knowledge of peculiar trade customs, and the rules maintained by labor unions. Certain kinds of work are performed by certain trades when it might appear reasonable that the work should be performed by other trades. The work should be specified for the trade that is supposed to do it, or disputes may arise.

CHARACTERISTICS OF A GOOD SPECIFICATION

62. Good Arrangement.—The specifications should be carefully arranged. The work of the various trades should be specified in the order in which it is to be done on the building. All items belonging to each trade should be grouped under the trade heading. The checking list in this Section will serve as a guide to a good arrangement.

63. Brevity and Completeness.—As few words as possible should be used in expressing what is desired. Repetition should be avoided. At the same time everything necessary to a complete description should be said, as the lack of completeness is a fruitful source of trouble. An article forgotten may mean an extra, which is something the owner must pay for contrary to expectations.

64. Clearness.—Simple, easily understood words and language should always be used. The words commonly used by mechanics should be understood and used in preference to more technical words.

AIDS IN SPECIFICATION WRITING

65. Old Specifications as Models.—A common method of writing specifications used in architect's offices is as follows: A specification of a building that is similar to that for which the new specification is to be written is used. Corrections, additions, and other changes required are written between the lines or on the borders of the pages, or on additional sheets of paper. When these changes have all been made, the whole specification is retyped and the necessary copies made. In many cases this method answers very well. There is always a chance of error, however, as one must remember work and material that is in the new building, but which was not included in the old building. This is overcome by the use of the checking list described later on. One advantage of this method of writing specifications is that satisfactory methods of expression are included in the old specification and can be transferred directly to the new specification.

It is advantageous to obtain, whenever possible, copies of specifications that have been written for various types of buildings by various writers. These specifications will serve as models in some respects, and often contain valuable hints as to the different ways of specifying different items.

66. Checking List.—A checking list is a systematic tabulation of all the items likely to be called for in an average specification that is more or less complete. It is an outline of the specifications. A writer having such a list can follow it and select headings, subheadings, and items that will have to be specified for the building for which he is preparing specifications.

67. The specification writer, in preparing specifications will have the plans before him, and will start at the beginning of the checking list, and will note each heading. He will decide whether or not this heading must be included in the specification. If the heading is to be included, the specification is written, following the list of subheadings and items mentioned in the list. If the checking list is very complete,

all the items necessary to mention will be called to the attention of the writer. If the checking list is well-arranged, a well-ordered specification will result. A checking list is merely a reminder, and the specification writer should add to the list from time to time items that he wishes to be reminded of in writing future specifications.

68. The material used in specifying the various items must be obtained from other specifications that have been written and used in buildings already erected, or the specification writer must make up suitable descriptions from his own information and experience.

USE OF SPECIFICATIONS

69. Estimating.—After the drawings and specifications have been completed, their first use is for the purpose of obtaining estimates. All the specifications and drawings may be taken by a contractor who expects to figure on all the work. In most cases, however, the mason contractor takes a set of drawings and the specifications that cover the mason's trades. The carpenter takes the drawings and all the specifications that cover the carpentry, painting, glazing, etc. The electrician, plumber, heating contractor, etc., each receive the drawings and specifications covering his respective work.

After the estimates have been submitted and delivered to the architect or owner, the most advantageous of them are selected. Contracts are entered into with the successful bidders, and the specifications, drawings, and contracts are signed by the owner and the bidders.

70. Revising Specifications.—It frequently happens that the bids received on certain specifications and drawings are too high, in which case the architect generally tries to modify his specifications by calling for less expensive materials and work. This cutting or revising of the specifications sometimes brings the price within satisfactory limits, and changing of the plans is avoided. When, however, the price is too high after revising the specifications, it becomes necessary to cut down

on the drawings. The size of the house is modified, special features are taken off, and the plans generally are redrawn.

71. When the cutting and revising have been done, the specifications rewritten, the drawings modified, and satisfactory estimates have been received, the specifications, drawings, and contracts are signed by the owner and the contractors. These signed documents should be carefully stored away in a safe, so that they will not be mislaid or used, and so that they can be referred to in case of any dispute.

72. Office Copy.—An exact duplicate of the signed set of specifications is typed, and is marked the Office Copy, and is kept in the architect's office as a guide in preparing the working drawings and details required for the work.

73. Numbering Specifications.—After the contracts have been signed, copies of the specifications are distributed to the various contractors. It is a good practice to number each set of specifications so that it may be identified. A record can then be kept of the location of each copy, and if desired, they can be collected at the completion of the job.

SPECIFICATION WRITING

74. General.—As has been pointed out, a specification writer should have a good knowledge of the drawings, his client's requirements, the construction, materials, and trade customs. From the drawings of the building and its various details he should be able to form a mental picture that will enable him to describe accurately the materials required and the workmanship and trade processes necessary to produce the building.

In every case, whether the building is large or small, the specification writer should be careful to cover all the necessary points, so as to protect the owner as well as the contractor from injustice, aggravation, and loss. A small contract is as important to the parties involved as is a large contract, and the architect should exercise the same care in protecting the interests of the parties to the contract in both cases.

75. How to Write a Specification.—When starting to write a specification, the aids already mentioned should be used. If an old specification is to be revised and used, the writer should begin at the first page and change the title to suit the new building and owner. He should continue throughout the specification, and add lines or paragraphs where required, or cut out lines and sentences that do not apply to the new work. When he has thoroughly revised the old specification and has made all the necessary changes, he should go over the headings, and compare the specifications with a good checking list, which will recall to the memory or suggest many points that should have been mentioned in the specifications. These points can then be added and the specifications finished, after which the specifications can be rewritten on the typewriter.

Another method is to work directly from the checking list, and lay out the entire specifications from the headings given in the list. The wording of the articles and items can be taken from old specifications, or the writer can depend upon his own information, experience, and memory.

76. How to Specify.—In writing a specification for any particular kind of work, it is necessary to specify the materials that are to be used, the processes involved in using the materials and the workmanship required to install and finish the work. The following specification will illustrate this statement:

> Face Brick.—All work so indicated or herein specified as being of face brick shall be composed of wire-cut, impervious, stiff-mud brick, burned to high vitrification, straight, true, and uniform in size, and carefully selected for uniformity in size and color. All face brick shall be of a light-gray or cream color. The make and color of the brick shall be subject to the approval of the architects.
>
> All face brick shall be laid up with flushed joints in mortar as specified later, of uniform width not exceeding $\frac{5}{16}$ inch, neatly struck with a beveled tool. All horizontal courses shall be straight and true to line and level. All face brick shall be laid in regular bond with concealed split diagonal headers, one such header to every sixth brick in a course.

The first part of the above specification deals with the material, its manufacture, and its characteristics. The second

part treats of the process of laying the brick, and the work to be done in completing the work.

77. In specifying a material there are several points that should be considered, such as its correct name, the manufacturer's name, trade-mark, catalog and size numbers, where obtained, manufacture, test for quality, dimensions, weight, color, quality or grade, samples, cementing materials, methods of joining or setting, anchoring, preparation for, preparation of materials, placing, finishing, protection, and guarantee, Some of these points will apply to every material, and those that apply should be mentioned in the specifications of the material. For example, in specifying a lavatory, the following description might be used:

> J. L. Mott Company's "Altoona" vitreous china lavatory 24″×20″, fitted with nickel-plated No. 9 "Primus" compression combination supply and waste fitting, $8\frac{3}{8}$″ nickel-plated supplies to wall, $1\frac{1}{2}$″ nickel-plated cast brass half-**S** trap with tubing nipple to wall. Plate No. 4222A.

It will be noted that the manufacturer's name, the trade-name, the kind of material, the name of the object, and the dimensions, are first given. Then follows a description of the attachments that form a part of the finished lavatory. Finally, there is given in the catalog a plate number that identifies the lavatory in the manufacturer's catalog.

78. Lumber, tile, glass, and so forth, are specified by giving the quality, manufacturer's grading rules, size, thickness, and color. For example, flooring may be specified "Flooring shall be $\frac{13}{16}$ inch by $3\frac{1}{4}$ inches face, tongued and grooved, No. 1 Common, plain sawn white oak." Tile might be specified as "Tile shall be No. 1 hexagonal vitreous gray tile, Commercial quality." Sand, broken stone, etc., are specified to meet certain conditions. For example, broken stone is specified "Broken stone for concrete shall be hard, durable, crushed granite, trap rock, flint limestone, or a clean gravel. Stone must be clean, and in no case containing over 1 per cent. of clay or other foreign matter. Stone must grade from $\frac{1}{4}$ inch up to $2\frac{1}{2}$ inches in its maximum diameter, except for reinforced concrete, when it shall not exceed $\frac{3}{4}$ inch in diameter."

79. Standardized Materials.—In specifying Portland cement, the specification writer can take advantage of the researches of the American Society for Testing Materials. This society has experimented and standardized the requirements for Portland cement. It is, therefore, easy to make a complete specification for Portland cement by specifying that the Portland cement shall comply with the standards adopted by the American Society for Testing Materials. The same is true of structural steel.

It is very essential to specify all the points, as already shown, stating explicitly what materials are to be furnished, not merely to say that "materials shall be of good quality," "well-made," or other loosely drawn phrases.

80. The methods of preparing materials, the proportions in which they are to be mixed, and the method of installing should always be described in specifying concrete, stucco, plastering, painting, and so forth.

81. Guarantees.—Special guarantees should be called for on kinds of the work on which failures are likely to occur, and damage result from the failure. Skylights, flashings, etc., should be guaranteed for 5 years, and four-ply composition roofs should be guaranteed for 10 years.

82. Lapses in Specifications.—In some cases the specification writer may specify certain articles in two specifications that are to be used on the same job, thus calling for a duplication of the work. On the other hand, he may omit the article in one specification, and it may possibly be omitted from both of the specifications. Thus, painting of steel work may be called for in the steel specifications and in the painter's specifications, or it may be accidentally omitted in both specifications. The specification writer should carefully avoid these conditions. When the work is specified twice, the cost of the building will be higher, and if the work is not specified, there will be an extra charge that will be annoying to the owner of the building.

83. Cooperation.—Particular care should be taken in specifying the work where one trade does part of it and another

trade completes it, so as to obtain proper cooperation. In iron stair work, for example, the marble or slate treads should be specified to be "furnished and set by the marble or slate contractor," and the specifications for the iron work should call for that contractor to "furnish all bearings and do all tapping and drilling to accommodate the work of the contractor for the slate and marble treads."

84. Work Built In.—The specification writer should not forget to specify work that must be done by one contractor in order to accommodate the work of another contractor. Thus, in the case of the contractor for the bricklaying, the contractor may have to build templets, steel beams, steel lintels, and anchors, for the steel contractor. If this work is not mentioned in the specifications, the brickwork contractor can properly refuse to do this work unless he receives additional payments. The contractor for the brickwork may have to set window frames, nailing blocks, anchors, etc., for the carpenter, and all of this work should be specified. It may be necessary to build chases, or leave pipe openings, in the walls for the plumber, the electrician, or the heating contractor. These matters should also be carefully specified in the brickwork specifications.

85. Cutting and Patching.—There are cases in which it is necessary to cut into work already in place to accommodate pipes, ducts, conduits, etc. It is always better to have the contractor whose work has been cut into do all the cutting and patching, or repairing, as his men have the skill and the tools for doing this kind of work. When a contractor will be required to do any cutting or patching, it should be so specified.

86. General.—The foregoing discussion will give a general idea of the methods used in specifying materials and workmanship, and the study of *Specification-Writing Memoranda* will give further insight into the uses, grading, manufacture, application, etc. of various materials. The model specifications which are given in *Specification Writing*, Part 2, should be carefully studied.

87. A checking list for the aid of specification writers given herewith is arranged according to the following general classification:

1. General Conditions
2. Operations Preliminary to Building
3. Excavation
4. Mason Contractors' Work
4.1 Foundation Work
4.2 Concrete Work (Plain)
4.3 Concrete Work (Reinforced)
4.4 Common Brickwork
4.5 Face Brickwork
4.6 Hollow Tile
4.7 Rubble-Stone Masonry
4.8 Cut-Stone Masonry
4.9 Architectural Terra Cotta
4.10 Terra-Cotta Fireproofing
4.11 Fireproofing Concrete
4.12 Waterproofing and Dampproofing
4.13 Furring and Lathing
4.14 Plastering (Interior)
4.15 Plastering (Ornamental)
4.16 Plastering (Exterior)
4.17 Marble (Interior)
4.18 Marble (Artificial)
4.19 Tile and Mosaic
4.20 Paving
5. Metal Trades
5.1 Structural Steel
5.2 Ornamental Metal Work
5.3 Sheet Metal
5.4 Fireproof Windows
5.5 Fireproof Doors and Trim
6. Carpentry
6.1 Framing
6.2 Exterior Woodwork
6.3 Interior Woodwork
6.4 Flooring
6.5 Roofing
6.6 Miscellaneous Carpentry
6.7 Hardware
7. Painting
8. Glazing
9. Plumbing
10. Electric Wiring
11. Heating
12. Ventilating

In certain places in the checking list will be found such references as on page 43, where, under 2 (*k*) is shown the reference 6-(*g*)-6. This refers to heading 6, which is Carpentry. Under this heading, on page 61 are found the letters. Under (*g*), Temporary construction, are several numbers, of which 6 is the one referred to. Thus, the reference 6-(*g*)-6 indicates Carpentry—Temporary construction—Fences.

The significance of this reference is that the item is taken care of under the specification of the carpenter work.

CHECKING LIST

1. General Conditions
 - (*a*) Definitions
 - (*b*) Documents
 - (*c*) Details and instructions
 - (*d*) Copies furnished
 - (*e*) Shop drawings
 - (*f*) Drawings on the work
 - (*g*) Ownership of drawings
 - (*h*) Samples
 - (*i*) The Architect's status
 - (*j*) The Architect's decisions
 - (*k*) Foreman, supervision
 - (*l*) Material, labor, appliances
 - (*m*) Inspection of work
 - (*n*) Correction before final payment
 - (*o*) Deductions for uncorrected work
 - (*p*) Correction after final payment
 - (*q*) Protection of work and property
 - (*r*) Emergencies
 - (*s*) Damage to persons
 - (*t*) Liability insurance
 - (*u*) Fire insurance
 - (*v*) Guaranty bonds
 - (*w*) Cash allowances
 - (*x*) Changes in the work
 - (*y*) Claims for extras
 - (*z*) Application for payments
 - (*A*) Certificates and payments
 - (*B*) Payments withheld
 - (*C*) Liens
 - (*D*) Permits and regulations
 - (*E*) Royalties and patents
 - (*F*) Use of premises
 - (*G*) Cleaning up
 - (*H*) Cutting, patching
 - (*I*) Delays
 - (*J*) Owner's right to do work
 - (*K*) Owner's right to terminate contract
 - (*L*) Contractor's right to stop work or terminate contract
 - (*M*) Damages
 - (*N*) Mutual responsibility of contractors
 - (*O*) Separate contracts
 - (*P*) Assignments
 - (*Q*) Subcontracts
 - (*R*) Relations of contractor and subcontractor
 - (*S*) Arbitration
2. Operations Preliminary to Building
 - (*a*) General conditions
 - (*b*) Scope of work
 - (*c*) Material removed by owner
 - (*d*) Material removed by contractor
 - (*e*) Protection of trees and walks
 - (*f*) Cutting down trees
 - (*g*) Grub out stumps
 - (*h*) Protection of adjoining property
 - (*i*) Wrecking
 1. Not endanger adjoining property
 2. Sprinkle dust
 3. Rubbish chute
 4. Remove rubbish
 - (*j*) Testing soil
 1. By borings
 2. By knowledge of surrounding properties
 3. By pits
 4. By crowbars

(*k*) Fences (See 6-(*g*)-6)
(*l*) Temporary sheds and sidewalks (See 6-(*g*)-7)
(*m*) Sidewalk bridge (See 6-(*g*)-8)
(*n*) Laying out work
1. Surveying
2. Contour maps
3. Batter boards
(*o*) Removing rubbish from site
3. Excavating
(*a*) General conditions
(*b*) Scope of work
(*c*) Stripping and stacking top soil
(*d*) Excavating earth
1. Methods used
2. Below frost
(*e*) Excavating rock
1. By blasting
2. By wedging
3. Mattresses
4. Storage of explosives
(*f*) Disposal of materials
1. Stacking
2. Hauling away
3. Over adjoining property
4. Used for filling and grading
5. Sand and gravel left for use
(*g*) Trenches
1. For walls and footings
(*a*) On solid earth
(*b*) No filled ground
(*c*) Graded for drainage
(*h*) Protecting adjoining structures
1. Shoring
2. Underpinning
(*i*) Sheet-piling banks of excavation
1. Placing
2. Bracing
(*j*) Disposal of water in excavation
1. By pumps
2. By waste drainage
(*k*) Filling
(*l*) Grading
4. Mason Contractor's Work
4.1 Foundation Work
(*a*) General conditions
(*b*) Scope of work
(*c*) Piles
1. Wood piles
2. Concrete piles
(*a*) Precast
(*b*) Cast in place
3. Steel piles
4. Driving piles
(*a*) Steam hammer
(*b*) Drop hammer
(*c*) Water jet
(*d*) Shoes and butt rings
(*e*) Overdriving prohibited
5. Protection of piles
6. Determination of penetration
7. Cutting off piles
8. Capping piles
(*a*) Concrete
(*b*) Stone
(*c*) Timber
(*d*) Caissons
1. Pneumatic
2. Open
4.2 Concrete Work—Plain
(*a*) General conditions
(*b*) Scope of work
(*c*) Materials
1. Sand
(*a*) Bank sand (pit sand)
(*b*) Graded
(*c*) Washed
(*d*) Screened
2. Stone Screenings
(*a*) Graded
(*b*) Washed
(*c*) Screened
3. Broken stone
(*a*) Kind of stone
(*b*) Hard and durable
(*c*) Washed
(*d*) Graded

4. Gravel (See broken stone)
 (*a*) Crushed
 (*b*) Graded
 (*c*) Washed
5. Slag
 (*a*) Crushed
 (*b*) Graded
 (*c*) Low-sulphur content
6. Cinders
 (*a*) Clean
7. Lime
 (*a*) Lump
 (*b*) Hydrated
8. Cement
 (*a*) Portland
 (*b*) Nonstaining
9. Integral waterproofing
 (*a*) Patent mixtures
 (*b*) Hydrated lime
10. Coloring Materials
 (*a*) Mineral colors, Dry
 (*b*) Pastes
11. Water
 (*a*) Clean
 (*b*) Free from acids and alkalies
 (*c*) Measured quantities
12. Bonding medium

(*d*) Storage of materials

(*e*) Testing
1. Samples
2. Inspection
3. American Society for Testing Materials
4. By owner, contractor, or architect

(*f*) Concrete
1. Proportions of materials
 (*a*) Lean mixtures
 (*b*) Rich mixtures
 (*c*) Waterproofing
 (*d*) Coloring
 (*e*) Measuring ingredients
2. Heating in cold weather
 (*a*) Tarpaulins and salamanders
3. Mixing
 (*a*) By hand, on platform
 1. Uniform color
 2. Uniform consistency
 (*b*) By machine
 1. Continuous mixer
 2. Batch mixer
 (*a*) Mix for one minute
4. Use before set
 (*a*) Before one-half hour
5. Retempering
 (*a*) Not to be done
6. Coloring
7. Nailing concrete

(*g*) Forms
1. Wood forms
 (*a*) Good sound dressed clean lumber
 (*b*) Placing and bracing
 1. Anchors and separators
 2. Clamps
 (*c*) Wetting and oiling
 (*d*) Cleaning out rubbish
 (*e*) Remain until concrete is set
 (*f*) Removing
 (*g*) Expansion joints
 (*h*) Forms for openings in walls
 (*i*) Cleaning of forms
 (*j*) Inspection and clean-out holes
 (*k*) Chamfers
2. Metal forms

(*h*) Depositing concrete
1. Thickness of courses
 (*a*) even layers
2. No separation of ingredients
 (*a*) Continuous placing
3. Tamping
4. Spading
5. Puddling
6. Over-dry concrete
7. Protection against weather
 (*a*) Freezing weather
 (*b*) Hot weather

1. Keep wet
8. Joints
(a) Stopping Work
(b) Vertical
(c) Horizontal
9. Removal of laitance

(i) Footings and foundation walls
1. Where shown on plans
2. Depth and thickness
3. Mixture to be used
(a) Proportions
4. Work built in
(a) Bolts
(b) Templets
(c) Provision for waterproofing
(d) Chases
(e) Holes for pipes
(f) Nailing pieces
(g) Sleeves
5. Grouting
(a) Under columns
(b) Under machinery
6. Cutting and patching
(a) After other trades
(b) For other trades
7. Finishing surfaces
(a) Smooth finish (Above grade, see Stucco)
(b) Waterproofed

(j) Floors, roofs, and sidewalks
1. All work in place before starting floor
2. On earth subbase
(a) Preparation of soil
(b) Cinder or sand bed
(c) Base
1. Proportions
2. Tamping in place
3. Thickness
(d) Surfaces
1. Proportions
2. Measuring
3. Thickness
4. Placed before base is dry
5. Troweling
6. Expansion joints
7. Surface hardeners
8. Waterproofing
9. Granite dust and grit
10. Keep wet
11. Grade to drain
12. Surface finish
13. Stopping work before dark
3. On arches or slabs
(a) Cinder concrete base
1. Thickness (to within 1″ of finished surface)
2. Proportions
3. Tamping
(b) Roof fill
1. Cinders
2. Graded to drainage points
3. Saddles and cant strips
4. Work built in
(a) Pipes all in place
(b) Register faces and boxes
(c) Floor boxes, Electric
(d) Manhole covers
(e) Trench covers
(f) Cleanout holes
(g) Traps
(h) Cesspools
(i) Septic tanks

(k) Machinery bases
1. Proportions
2. Setting bolts
3. Templets
4. Waterproofing
5. Finishing surfaces
6. Sleeves and chases

(l) Manholes
(m) Pits
(n) Sumps
(o) Trenches
(p) Stairs and steps
(q) Curbs and sidewalks
1. Curb bars

(*r*) Cast concrete blocks
1. Steps
2. Thresholds
3. Wall blocks
4. Coping

(*s*) Cutting for other trades
1. See General conditions

4.3. Reinforced Concrete Work
(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings
1. Schedule of drawings
2. Supplementary drawings
3. Bending diagram schedules

(*d*) Materials
1. Reinforcing steel
(*a*) Types of reinforcement
1. Plain deformed bars
2. Truss and stirrup attachments
3. Unit frame systems
4. Wire cloth and expanded metal
5. Accessories

(*b*) Systems and types of construction
1. Kahn
2. Mushroom, etc.

(*c*) Elastic limit
(*d*) Ultimate strength
(*e*) Elongation
(*f*) Cleaning steel
(*g*) Inserts

(*e*) Storage of materials (See 4.2-(*d*))
(*f*) Testing (See 4.2-(*e*))
(*g*) Concrete (See 4.2-(*f*))
1. Cinder fill

(*h*) Forms
1. Wood forms (See 4.2-(*g*)-1)
2. Metal forms (See 4.2-(*g*)-2)
3. Design of forms

(*i*) Depositing (See 4.2-*h*)
(*j*) Footings and foundation walls (See 4.2-(*i*))
1. Work built in
(*a*) Placing reinforcement
(*b*) Spacing rods
(*c*) Spacing stirrups
(*d*) Chairs and separators
(*e*) Wiring
(*f*) Splicing and connections
(*g*) Protection and covering
(*h*) Steel grillage
(*i*) Machinery

(*k*) Piers and columns
1. Vertical reinforcement
2. Horizontal reinforcement
3. Spirals
4. Wiring
5. Covering
6. Covering steel
7. Finishing surfaces
(*a*) Straight, true
(*b*) Smooth rubbed
(*c*) Beveled angles
8. Proportions for concrete

(*l*) Slabs, beams, and lintels
1. Floors and roofs
(*a*) Temporary floors
1. Floordomes
2. Johnson
3. Combination

(*b*) Types of reinforcement
(*c*) Depositing concrete (See 4.2-*h*)
(*d*) Thickness of slab
(*e*) Setting reinforcement
(*f*) Floor around reinforcement
(*g*) To produce smooth surface

(*m*) Steps and stairs
(*n*) Machine foundations
(*o*) Miscellaneous work
(*p*) Work built in
1. Hangers and inserts
2. Ties for terra cotta, brick, and stone

(*q*) Protection
1. Freezing weather
2. Hot weather

3. Excessive loads
4.4. Common Brickwork
(*a*) General conditions
(*b*) Scope of work
(*c*) Materials
1. Bricks
(*a*) Common
1. Hard-burned
2. Well-shaped
3. Selected for color and shape
4. Quality—Absorption
(*b*) Hollow brick
(*c*) Sand-lime brick
(*d*) Fire-brick
(*e*) Vitrified brick
(*f*) Size of brick
(*g*) Jumbo brick
2. Mortar
(*a*) Sand (See 4.2-(*c*)-1)
(*b*) Lime (See 4.2-(*c*)-7)
(*c*) Cement (See 4.2-(*c*)-8)
1. Portland cement
2. Non-staining cement
(*d*) Fire clay
(*e*) Water (See 4.2-(*c*)-11)
(*f*) Coloring (See 4.2-(*c*)-10)
(*g*) Proportions
1. Lime-cement mortar
2. Cement-lime mortar
(*h*) Mixing
(*d*) Laying brickwork
1. Plumb, level, and true
2. Bond
3. Joints
(*a*) Size
(*b*) Full of mortar
(*c*) Finish
(*d*) Pointing
4. Laying in freezing weather
(*a*) Dry
(*b*) Brick and water heated
(*c*) Tarpaulins
(*d*) Salamanders
5. Laying in hot weather
(*a*) Well wet
6. Scaffolds
(*a*) For outside work
7. Cleaning down
(*a*) Efflorescence
8. Pointing
9. Waterproofing
10. Protection
(*a*) Boarding
(*b*) Tarpaulins
(*c*) Covering
(*e*) Work to be done
1. Walls, piers, etc.
(*a*) Hollow walls
(*b*) Wall copings (See stone) (See Tile)
2. Chimneys
(*a*) Fireplaces
(*b*) Flues
(*c*) Flue linings
(*d*) Ashpits
(*e*) Cleanout doors
(*f*) Fire-brick linings
(*g*) Copings
1. Stone
2. Brick
3. Terra cotta
4. Concrete
3. Walks and steps
4. Paving
(*a*) Vitrified brick
5. Pipe trenches
6. Fire stops
7. Chases, slots, and centers
8. Arches
(*a*) Window and door
(*b*) Relieving arches
(*c*) Flat arches
9. Backing
(*a*) Stone and terra cotta
(*b*) Face brickwork
(*c*) Steel work
10. Bonding stone and terra cotta
11. Hollow brick furring
12. Cess pools and septic tanks
13. Work built in

(*a*) Furnished by contractor or owner
1. Throats and dampers
2. Ashpit doors
3. Raggle blocks
4. Thimbles
5. Cleanout doors
6. Anchors in general
7. Clamps
8. Wall plugs
9. Coal-hole covers
10. Manhole covers
11. Coal chutes
12. Coal-chute doors
13. Shutter eyes
14. Window - cleaning devices

(*b*) For steel contractor: Furnished by steel contractor
1. Templets
2. Anchors
3. Structural iron

(*c*) For stone and terra-cotta contractor
1. Anchors, furnished by stone or terra-cotta contractor

(*d*) For heating contractor
1. Chases
2. Sleeves, furnished by heating contractor
3. Trenches
4. Trench covers, furnished by ornamental-iron contractor
5. Boiler setting (See 11-*j*-3-(*g*))

(*e*) For plumbing contractor
1. Chases
2. Trenches
3. Sleeves, furnished by plumbing contractor
4. Manholes, furnished by ornamental-iron contractor
14. Cutting and patching
(*a*) After other trades
(*b*) For other trades

4.5. Face Brickwork
(*a*) General conditions
(*b*) Scope of work
(*c*) Materials
1. Bricks
(*a*) Pressed
(*b*) Wire-cut
(*c*) Fire-flashed
(*d*) Molded
(*e*) Samples to be submitted
(*f*) Size and shape
1. Arch-brick ground
(*g*) Color
2. Mortars
(*a*) Sand (See 4.2-(*c*)-1)
1. White sand
2. Grits
(*b*) Lime (See 4.2-(*c*)-7)
(*c*) Cement (See 4.2-(*c*)-8)
1. Portland
2. Non-staining
3. White portland
(*d*) Coloring
(*e*) Proportions
(*f*) Mixing (See 4.4-(*c*)-2)
(*g*) Freezing weather (See 4.3-(*q*))
(*d*) Laying brickwork
1. Bonds
(*a*) American
(*b*) English
(*c*) Flemish
(*d*) Special
2. Joints (See 4.4-(*d*)-3)
(*a*) Struck
(*b*) Tooled
(*c*) Rough
(*d*) Smooth
(*e*) Rough cut
(*f*) Weathered
(*g*) V-shaped
(*h*) Raked
(*i*) Rodded

(*e*) Work to be done
1. Facing walls
2. Fireplaces and mantels
(*a*) Hearth
(*b*) Back
3. Chimney breasts
4. Paving
5. Fences
(*f*) Cutting and patching
1. After other trades finish
2. For other trades
(*g*) Enameled brick
1. Bricks
2. Mortar
3. Bond
4. Joints
5. Laying
(*h*) Cleaning brickwork
1. Acid
2. Efflorescence

4.6. Hollow Tile
(*a*) General conditions
(*b*) Scope of work
(*c*) Materials
1. Tile
(*a*) Box-shaped
(*b*) Interlocking
(*c*) H-Shaped
(*d*) Tex-tile
2. Special tile
(*a*) Jamb blocks
(*b*) Sill blocks
(*c*) Lintel blocks
(*d*) Corner blocks
(*e*) Closers
(*f*) Arch blocks
(*g*) Telephone conduit
(*h*) Back-up tile
(*i*) Silo blocks
(*j*) Slabs
(*k*) Glazed
3. Mortar (See 4.5-(*c*)-2)
(*d*) Laying
1. Direction of webs
2. Anchoring
(*e*) Walls
1. Facing walls
(*a*) Brick
(*b*) Stucco
2. Concentrated supports
3. Chases
4. Backing up brick or stone
(*f*) Work to be done (See Brickwork)
(*g*) Chimneys and fireplaces
(*h*) Cleaning and pointing (See 4.5-(*d*)-2 and 4.5-(*h*))
(*i*) Cutting and patching (See Brickwork 4.5-(*f*))

4.7. Rubble-stone Masonry
(*a*) General conditions
(*b*) Scope of work
(*c*) Kinds of masonry
1. Plain rubble
2. Field stone
3. Coursed rubble
4. Backing
(*d*) Mortar (See 4.4-(*c*)-2)
(*e*) Joints (See also 4.4-(*d*))
1. Flush
2. Struck
3. Weathered
4. Tooled
5. Rodded
6. Beaded
7. V-Shaped
8. Recessed
(*f*) Laying
1. Rough Cutting
2. Bedding in mortar
3. Spalls
4. Joints
5. Colored mortar
6. Bonding
7. Natural bed
8. Wetting
9. Anchoring
10. Backing
(*g*) Protection
(*h*) Cleaning
(*i*) Pointing
(*j*) Work to be done

1. Walls and piers
2. Chimneys
3. Fireplaces

(*k*) Work to be built in. (See 4.4-(*e*)-11)

4.8 Cut-Stone Work

(*a*) General conditions
(*b*) Scope of work
(*c*) Shop and setting drawings
1. Approved by architect

(*d*) Models
1. Furnished by contractor
2. Furnished by owner
3. Approved by architect

(*e*) Samples to be submitted
1. Approved by architect

(*f*) Materials
1. Stone (Natural)
(*a*) Granite
(*b*) Limestone
(*c*) Marble
(*d*) Sandstone
(*e*) Bluestone
2. Artificial stone
(*a*) Solid blocks
(*b*) Hollow blocks
1. Concrete blocks
(*a*) Kind and machine
(*b*) Mortar
(*c*) Laying

(*g*) Mortars (See 4.5-(*c*)-2)
1. Non-staining cement
2. White sand
3. Marble dust
4. Backing mortar

(*h*) Kind of masonry
1. Ashlar
2. Coursed ashlar
3. Block-in-course
4. Random course
5. Broken ashlar
6. Dimension

(*i*) Finish of stone
1. Rock-face and pitch-face
2. Pointed, rough and fine
3. Broached
4. Rubbed
5. Bush-hammered
6. Rusticated
7. Margins

(*j*) Shop work
1. Beds and joints
2. Checking out
3. Lewis holes
4. Washes and drips
5. Reveals and returns
6. Thickness
7. Miter and false joints
8. Carving in shop
9. Carving in field
10. Packing
11. Shipping
12. Marking

(*k*) Setting stone
1. Natural bed
2. Derricks
3. Lewises
4. Wedges in joints
5. Open joints for pointing
6. Sills bedded at ends only
7. Bracing projecting stones
8. Top joints in copings calked
9. Anchoring
10. Clamping
11. Dowels
12. Back-plastering

(*l*) Cleaning and pointing
1. Brushing
2. Washing with dilute acid
3. Washing with soap powders
4. Sand blast
5. Raking joints
6. Pointing with special mortar

(*m*) Cutting and patching
(*n*) Protection, by boards, etc.
(*o*) Centering (See Carpenter Work)

4.9. Architectural Terra Cotta

(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings

1. Shop
2. Setting
3. Approved by architect

(*d*) Models
1. Full-size clay
2. Full-size plaster
3. Submit photos
4. Models inspected
5. Models approved by architect
6. Models paid for by owner
7. Models paid for by contractor
8. Models destroyed

(*e*) Materials
1. Terra Cotta
 (*a*) Hard burned
 (*b*) Straight, true and even
 (*c*) No warps and bends
 (*d*) Glazed
 1. Coating and spotting
 2. Slipping
 3. Spraying
 4. Standard or plain
 5. Vitreous
 6. Matt-glazed, or enameled
 7. Full - glazed, or enameled
 8. Polychrome, or enameled
 9. Fire - gilded, or enameled
 (*e*) Texture
 1. Imitation stones
 2. Tooled
 3. Drag surface
 (*a*) Smooth drag
 (*b*) Light drag
 (*c*) Rough drag
 (*f*) Samples submitted
 (*g*) Sizes and thicknesses
 (*h*) Guarantee
 1. Against cracking
 2. Against crazing
 3. Against loss of color
 (*i*) Mortars (See 4.4-(*c*)-2)

(*f*) Workmanship
1. Molding and fitting
 (*a*) Blocks fitted together at shop
 (*b*) Ground true
 (*c*) Additional spare blocks
 (*d*) Washes and drips
 (*e*) Joints
 1. Raised
 2. Filleted
 (*f*) Reglets
 (*g*) Holes for anchor ties
 (*h*) Thickness of ribs
 (*i*) Numbering
2. Delivery
3. Stacking
 (*a*) Inverse order as required
 (*b*) Boards between
 (*c*) Covering with tarpaulins
 (*d*) Handling blocks
4. Setting
 (*a*) Backing up like stone
 (*b*) Filling where loaded
 (*c*) Anchoring, Hangers
 (*d*) Fitting
 (*e*) Bedding in mortar
 (*f*) Steel supports
 (*g*) Boxing and protection
 (*h*) Terra-cotta foreman
 (*i*) Replacement of damaged pieces
 (*j*) Washing and pointing
 1. Dilute acid
 2. Washing powder
 (*k*) Bracing projecting blocks
5. Superintendence
 (*a*) Men furnished by manufacturer

4.10. Terra-Cotta Fireproofing
(*a*) General conditions
(*b*) Scope of work
(*c*) Description of terra cotta
1. Kinds
 (*a*) Porous

(*b*) Semiporous
(*c*) Dense
2. Density test
(*a*) Absorption of water
3. Thickness of web
4. Strength
5. Requirements of building laws
6. Guastavino tile
(*d*) Laying
1. Cement mortar
2. Wetting blocks
3. Bedding in full bed of mortar
4. Arches on centers
5. Partitions plumb
6. Column coverings
(*a*) Set plumb
(*b*) Clipped
(*c*) Wired
(*d*) Filled with mortar
(*e*) Minimum thickness outside of steel
(*f*) Building laws
7. No broken tile used
(*e*) Work to be done
1. Floor and roof arches
(*a*) Flat arches
1. Side Construction
(*a*) Skew backs
(*b*) Lengtheners
(*c*) Keys
(*d*) Centering
(*e*) Tie rods
(*f*) Crowning
2. End construction
(*a*) Flat arches, etc.
3. Combination flat arches
(*a*) Skews
(*b*), (*c*), etc.
4. Reinforced flat - tile arches
(*a*) Reinforcement
(*b*) Segmental arches
1. Long span
2. Short span
3. Guastavino
(*c*) Long-span floor systems
1. Herculean
2. Johnson
3. Combination hollow tile and reinforced concrete
(*a*) One-way
(*b*) Two-way
2. Protection of girders
(*a*) Clip tiles
(*b*) Soffit tiles
(*c*) Stretchers
(*d*) Skews
3. Column fireproofing
(*a*) Thickness
1. Building laws
(*b*) Joints filled with mortar
(*c*) Concrete between terra cotta and iron
(*d*) Wiring, clips, and anchors
(*e*) Pipe spaces
4. Partitions
(*a*) Thickness
(*b*) Wedged on top
(*c*) Stiffening, Truss wire
(*d*) Pipe chases
(*e*) Bricks
5. Furring
(*a*) Split
(*b*) Hollow brick
6. Book tile
(*a*) Rebated
7. Ceilings
(*a*) Timbrel vaults
8. Cutting and patching

4.11. Fireproofing With Concrete
(*a*) General conditions
(*b*) Scope of work
(*c*) Materials
1. Cement (See 4.2-(*c*)-8)
2. Sand (See 4-2.(*c*)-1)
3. Lime (See 4.2-(*c*)-7)

4. Aggregates (See 4.2-(*c*)-2, 3, 4, 5, and 6)
5. Concrete
 (*a*) Proportions
6. Reinforcement
7. Centers (See Carpentry)

(*d*) Work to be done
1. Floor and roof construction
 (*a*) Slabs, Loose-bar reinforcement
 (*b*) Slabs, Woven-wire reinforcement
 (*c*) Slabs, Expanded-Metal reinforcement
 (*d*) Arched construction
 (*e*) Self-centering
 (*f*) Floor domes
2. Beams and girders
 (*a*) Wrapping bottom flange
3. Columns
 (*a*) Forms of wood
 (*b*) Forms of expanded metal
 (*c*) Inside terra cotta
 (*c*) Cement gun
 (*e*) Column fireproofing
4. Partitions
 (*a*) Solid-plaster partitions
 1. Steel studs
 2. Sheet-Metal studs
 3. Self-centering lath
 4. Studless
 (*b*) Hollow plastered partitions
 1. Steel studs
 2. Sheet-metal studs
 (*c*) Molded cement blocks
5. Cutting and patching

4.12. Waterproofing and Dampproofing
(*a*) General conditions
(*b*) Scope of work
(*c*) Systems
1. Membrane
2. Surface applied
3. Integral

(*d*) Materials
1. Asphalt
2. Coal-tar pitch
3. Felt
4. Canvas
5. Patent preparations, Integral
6. Surface applications
 (*a*) Paints
 (*b*) Coatings
7. Samples submitted

(*e*) Soil conditions
(*f*) Preparation of surfaces
1. Walls, dry and smooth
2. Expansion joints
3. Construction joints

(*g*) Through walls to cellar
(*h*) Installation of membrane
1. Number of plies
2. Mopping
3. Protection-canvas
4. Finishing
5. Masonry protection

(*i*) Installation of integral waterproofing
1. Character of work
2. Special precautions in placing

(*j*) Cellars
(*k*) Pits
(*l*) Pipes through walls
(*m*) Repairs
(*n*) Guarantee

4.13. Furring and Lathing
(*a*) General conditions
(*b*) Scope of work
(*c*) Materials
1. Wood furring
 (*a*) Securing in place
 (*b*) Straightening
2. Metal furring
 (*a*) Rolled-steel channels or angles
 (*b*) Bent sheet-metal
 1. Prongs
 (*c*) V-Furring in lath

(*d*) Rods in lath
(*e*) Fastening
1. Wiring
2. Staples
3. Clips
4. Bolts
5. Rivets
6. Expansion bolts
7. Nails
3. Terra cotta furring
4. Lath
(*a*) Perforated metal
(*b*) Expanded metal
(*c*) Metal fabric
(*d*) Stiffened
(*e*) Reinforced
1. V-Ribs
2. T-Ribs
3. Hy-rib
4. Trussit
5. Corr-mesh
(*f*) Painted or galvanized
(*g*) Wood lath
(*h*) Byrkit lath
(*i*) Bishopric board
5. Corner beads
(*a*) Bull-nose beads
6. Base grounds
7. Built-in picture molds
8. Plaster board
(*d*) Work to be done
1. Bent furring
2. Furred ceilings
3. False work furred
(*a*) Beams
(*b*) Cornices
(*c*) Columns
(*d*) Pilasters
(*e*) Coves
(*f*) Arches
(*g*) Window and door jambs
4. Walls and partitions
(*a*) Single
(*b*) Double
(*c*) Solid
(*d*) Metal studs
5. Stair soffits
6. Lathing
(*a*) Over all furring
(*b*) Over all studding
(*c*) Under all joists
(*d*) Window and door jambs
(*e*) Over door bucks
(*f*) Over heat ducts
(*g*) Breaking joints, wood lath
(*h*) Behind wainscots
(*i*) Behind bases

4.14. Plastering (Interior)
(*a*) General conditions
(*b*) Scope of work
(*c*) Preliminary examination
1. Walls, Plumb and true
2. Furring and lathing, Well-secured
(*d*) Materials
1. Lime
(*a*) Lump lime
(*b*) Hydrated lime
(*c*) Slaking lime
2. Patent plasters (Gypsum)
(*a*) Pulp
(*b*) Sanded
(*c*) Unsanded
(*d*) Finishing plaster
1. Trowel finish
2. Sand float
3. Keene's cement
(*a*) Regular
(*b*) Fine
4. Special mortar and finish
(*a*) Asbestos plaster
5. Caen Stone
6. Sand
(*a*) Brown
(*b*) White
7. Marble dust
8. Plaster of Paris
9. Hair, fiber, and asbestos
(*e*) Workmanship or application
1. Number of coats

(a) Scratch coat
1. Scratching
(b) Brown coat
1. Straightening
2. Screeding
(c) Finish coat
1. Troweled
2. Floated
3. Plain finish
4. Sand finish
(d) On wood lath
1. Two-coat work
2. Three-coat work
(e) On metal lath
1. Two-coat work
2. Three-coat work
(f) On brick, terra cotta, and gypsum blocks
1. Two-coat work
(g) On plaster boards
1. Two-coat work
(h) On concrete
1. Bond plaster
(i) Other surfaces
2. Mixing mortar
(a) Proportions of coats
(b) Manufacturer's directions
3. Applying mortar
(a) Forming key
(b) Scratching
(c) Screeding
(d) Polishing surfaces
(e) Thickness
(f) Work to be done
1. All lathed work
(a) Back of wainscots
(b) Back of bases
2. Walls and ceilings
3. Stair soffits
4. Beams
5. Arches
6. Window and door jambs
7. Wainscotings
(a) Keene's cement
(b) Tiles
(c) Portland cement
8. Coves and bull-nosed corners
9. Patching
(g) Protection
1. Effects of freezing and heat
2. Window screens
3. Temporary heat
4. Wetting
(h) Whitewashing
(i) Remove rubbish
1. Broom clean

4.15. Plastering (Ornamental)
(a) General conditions
(b) Scope of work
(c) Materials
1. Lime
2. Sand
3. Plaster of Paris
(d) Models and drawings
(e) Work to be done
1. Cornices
2. Ornaments
3. Capitals
4. Brackets
5. Panels
6. Dentils
7. Modillions
8. Composition ornament
9. Moldings
(a) Run work
(b) Cast work
(f) Patching
(g) Remove rubbish

4.16. Plastering (Exterior)
(a) General conditions
(b) Scope of work
(c) Preparation of surfaces
(d) Materials (See 4.14-(c))
1. Colored aggregates
2. Mortar colors
3. Waterproofing
(a) Paint
(b) Integral
4. Magnesite stucco
5. Lime stucco

6. Cement stucco
(*e*) Application (See 4.14-(*e*)-3)
1. Retempering
2. Spraying wood lath
3. Spraying masonry
4. Scratch coat
5. Intermediate coat
6. Finishing coat
7. Thickness of coats
8. Back plastering
(*f*) Finishes
1. Smooth troweled
2. Stippled
3. Sand floated
4. Sand sprayed
5. Rough cast
6. Pebble dash
7. Applied aggregate
8. Exposed aggregate
9. Mortar colored
10. Waterproof painting
(*g*) Overcoating
(*h*) Composition and staff

4.17. Interior Marble, Slate, and Glass
(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings and models
(*d*) Samples
(*e*) Materials
1. Marble
(*a*) Kinds
(*b*) Qualities and defects
(*c*) Sizes and thicknesses
(*d*) Finish
2. Slate
(*a*) Kinds
(*b*) Qualities and defects
(*c*) Sizes and thicknesses
(*d*) Finish
3. Structural glass
(*a*) Kinds
(*b*) Qualities and defects
(*c*) Sizes and thicknesses
(*d*) Finish
4. Setting materials
(*a*) Portland cement (See 4.2-(*c*)-8)
(*b*) Plaster of Paris (See 4.15-(*c*)-3)
(*c*) White lead or putty
(*d*) Keene's cement
5. Anchors, clamps, dowels, expansion bolts, etc.
(*f*) Work to be done
1. Bases
2. Plinths
3. Counters
4. Hearths and facings
5. Mantels
6. Pavements
7. Saddles
8. Shelving
9. Sills
10. Stairs
(*a*) Treads
(*b*) Risers
(*c*) Newels
(*d*) Rails
(*e*) Platforms
11. Toilet rooms
(*a*) Partitions
(*b*) Backs
(*c*) Jambs
(*d*) Wainscots
12. Closets
(*a*) Partitions
(*b*) Backs
(*c*) Jambs
13. Urinals
(*a*) Backs
(*b*) Stalls
(*c*) Caps
(*d*) Floor slabs
14. Shower baths
15. Trim
(*a*) Architraves
(*b*) Bases
(*c*) Ceilings
(*d*) Columns
(*e*) Door and window trim
(*f*) Pilasters

(*g*) Wainscot
(*g*) Setting
1. Structural supports
2. Backing up
3. Secure with anchors, clamps, etc.
4. Finish, polishing
(*h*) Protection of work
1. Repairing damaged or defective work
(*i*) Removal of rubbish
4.18. Artificial Marble
(*a*) General conditions
(*b*) Scope of work
(*c*) Marbles to be imitated
(*d*) Samples
(*e*) Models
(*f*) Materials
1. Keene's cement (See 4.14-(*d*)-3)
2. Gypsum plaster (See 4.14-(*d*)-2)
3. Coloring Material
(*g*) Work to be done
1. (See Marble Work)
(*h*) Finish of surfaces
(*i*) Patching
(*j*) Protection
(*k*) Removal of rubbish
4.19. Tile and Mosaic
(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings, models, and samples
(*d*) Materials
1. Tile
(*a*) Ceramic mosaic
(*b*) Vitreous or semivitreous
(*c*) Paving
(*d*) Inlaid
(*e*) Quarry
(*f*) Glazed
(*g*) Enamel
(*h*) Plastic
(*i*) Faience
2. Mosaic
(*a*) Pebble ceramic
(*b*) Terrazzo
(*c*) Marble
(*d*) Glass
(*e*) Vitreous
(*e*) Preliminary work
1. Preparating of foundation bed
(*a*) New work
(*b*) Over old floors
(*c*) Concrete bed
(*d*) Mortar bed
(*e*) Scratch coat
(*f*) Reinforcement
(*g*) Metal lath
(*h*) Tar paper
(*f*) Work to be done
1. Bases
2. Ceilings
(*a*) Guastavino arches
3. Fireplaces
(*a*) Facings and hearths
4. Mantels
5. Paving
(*a*) Mortar
(*b*) Grout
(*c*) Rubbing down
6. Mosaic floors
(*a*) Borders
(*b*) Marble border
7. Terrazzo and granolithic floors
8. Tile floors
9. Trim
(*a*) Door and window trim
(*b*) Wainscot
10. Walls
(*a*) Ornamental work
(*b*) Frieze
(*c*) Panels
(*d*) Bases
(*g*) Setting
1. Floating
2. Buttering
(*h*) Joints
1. Width and color

2. Non-staining cement
3. Expansion joints

(*i*) Surface finish
1. Rubbing down
2. Cleaning and pointing

(*j*) Protection of the work

(*k*) Warranty
1. Term of years
2. Crazing, loosening, or developing defects

4.20. Paving

(*a*) General conditions

(*b*) Scope of work

(*c*) Materials
1. Magnesite
2. Mastic
3. Asphalt or tar
4. Concrete (See 4.2)
5. Marble (See 4.17-(*e*))
6. Stone, or flag, pavement
7. Brick (See 4.4-(*e*)-4)
8. Promenade tile
9. Wood pavement
10. Composition pavement
11. Patent pavement
12. Rubber pavement

(*d*) Samples.

(*e*) Preliminary work
1. Preparation of foundation beds
 (*a*) Waterproofing
2. Backing for base and wainscots, by others

(*f*) Application
1. Directions of manufacturers
2. Cementing material
 (*a*) Cement
 (*b*) Patent binders
 (*c*) Asphalt or tar
3. Finishing surfaces

(*g*) Work to be done
1. Exterior pavements
2. Interior pavements
3. Stair treads

(*h*) Cutting and patching, cleaning

(*i*) Protection

(*j*) Guarantee

(*k*) Removal of rubbish

5. Metal Trades

5.1. Structural Steel

(*a*) General conditions

(*b*) Scope of work

(*c*) Drawings
1. Architectural drawings
2. Structural drawings
3. Shop drawings
4. Figured dimensions to govern

(*d*) Materials
1. Standards of A. S. T. M. to be part of specification
2. Rolled steel
3. Cast steel
4. Cast iron

(*e*) Quality of workmanship

(*f*) Inspection and tests
1. Paid for by owner
2. Paid for by contractor
3. Reports to be made to architect

(*g*) Shop fabrication
1. Straightening material
2. Drilling, punching, and reaming
3. Riveting
4. Assembling

(*h*) Delivery at building

(*i*) Erection
1. Field rivets and bolts
2. Grillage and base plates
3. Centers and grades
4. Plumbing and levels
5. Riveting
 (*a*) By hand
 (*b*) By machine

(*j*) Painting
1. Kinds of paint
2. Shop coat
3. Surfaces to be dry
4. Items bedded in concrete not painted

5. Inaccessible surfaces painted before assembling
6. Field coat
 (*a*) Contrast with shop coat

(*k*) Work to be done
1. Anchors
2. Bearing plates
3. Bulkhead framing
4. Columns and bases
5. Cornice brackets
6. Floor and roof frames
7. Foundation work
8. Hanging ceiling
9. Lintels
10. Partition framing
11. Penthouse and bulkhead framing
12. Roof framing
13. Skylight framing
14. Trusses
15. Other structural work

(*l*) Protection of structural work

5.2. Ornamental Metal Work
(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings
1. Architect's drawings
2. Shop drawings

(*d*) Models
(*e*) Materials
1. Cast iron
 (*a*) Finishes
2. Wrought iron
 (*a*) Finishes
3. Bronze
 (*a*) Cast
 (*b*) Wrought
 (*c*) Extruded
 (*d*) Alloys
 (*e*) Finishes
 (*f*) Color
 (*g*) Hand chasing of ornament
4. Brass
 (*a*) Cast
 (*b*) Wrought
 (*c*) Drawn
 (*d*) Finishes
 (*e*) Color
 (*f*) Hand-chasing of ornament

(*f*) Workmanship
1. Castings
2. Shop fabrication
3. Large sections
4. Joints made invisible
5. Welds without breaks or shoulders
6. Handwork of finishing
7. Shop coat of paint

(*g*) Installation of work
1. Fastening and anchoring
2. Fitting
3. Connecting with masonry
4. Protecting masonry from stains

(*h*) Work to be done
1. Stairs
2. Elevator work
3. Railings, fences, and gates
4. Gratings, grilles, registers
5. Fire escapes
6. Doors and windows
7. Sidewalk lights
8. Miscellaneous items

5.3. Sheet-Metal Work
(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings
1. Shop drawings

(*d*) Materials
1. Steel
 (*a*) Galvanized
 (*b*) Rust-resisting
 (*c*) Gauge
2. Iron
 (*a*) Galvanized
 (*b*) Rust-resisting
 (*c*) Gauge
3. Copper
 (*a*) Hot-rolled
 (*b*) Cold-rolled

(*c*) Gauge
(*d*) Qualities
4. Zinc
(*a*) Gauge
5. Monel Metal
(*a*) Qualities
(*b*) Gauge and weight
6. Lead
(*a*) Cast
(*b*) Rolled
(*c*) Weights and qualities
7. Tin and terne plates
(*a*) Gauge and coating
(*b*) Brand
8. Other metals
(*a*) Qualities and weights
9. Felt
(*a*) Weight and thickness
10. Solder
(*a*) Proportions of metals
(*e*) Fabrication
1. Joints or seams
2. Raw edges turned under or rolled
3. Reinforcement of stamped work
(*f*) Work to be done
1. Flashings
2. Gutters
3. Leaders
4. Skylights and ventilators
5. Columns and cornices
6. Crestings and finials
7. Metal ceilings
8. Siding
9. Marquises
10. Trim
(*a*) Window and door
(*b*) Wainscoting
(*c*) Corner boards
(*d*) Paneling
11. Miscellaneous
(*g*) Installation of work
1. Nailing strips and blocks
2. Weather-tight joints
3. Field anchors and bracing
4. Connection with adjoining work
5. Allowance for expansion and contraction
6. Painting
(*h*) Guarantee
5.4. Fireproof Windows
(*a*) General conditions
(*b*) Scope of work
(*c*) Sheet-metal windows
1. Types of windows
(*a*) Double-hung
(*b*) Counter-balanced
(*c*) Pivoted
(*d*) Fixed
2. Materials
(*a*) Galvanized steel
(*b*) Galvanized rust-resisting metal
(*c*) Copper
3. Underwriters' requirements
4. Standard construction
5. Special construction
6. Hardware
7. Installation of work
8. Final adjustment
(*d*) Steel windows
1. Types of windows
(*a*) Fixed
(*b*) Double-hung
(*c*) Counter-balanced
(*d*) Casement
(*e*) Reversible
2. Shop drawings
3. Materials
4. Weathertightness
5. Methods of operation
6. Fabrication of work
7. Glazing, putty, beads
8. Hardware
9. Installation of work
10. Final adjustment
5.5. Fireproof Doors and Trim
(*a*) General conditions
(*b*) Scope of work
(*c*) Hollow metal

1. Shop drawings
2. Materials
 (*a*) Furniture stock
 1. Gauge
 (*b*) Rust-resisting iron
 1. Gauge
 (*c*) Bronze
 1. Gauge
 (*d*) Brass
 1. Gauge
3. Fabrication
 (*a*) Welding
 (*b*) Paneling
 (*c*) Insulation
 (*d*) Reinforcement
4. Finish of surfaces
 (*a*) Painted
 (*b*) Baked enamel
 (*c*) Grained to imitate wood
5. Work to be done
 (*a*) Steel bucks
 (*b*) Doors
 (*c*) General trim
 (*d*) Hardware and attachments
6. Cutting and fitting
7. Adjusting

(*d*) Kalamein work
1. Materials
 (*a*) Steel or rust-resisting iron
 1. Gauge
 (*b*) Bronze or brass
 1. Gauge
 (*c*) Wood for cores
2. Finish of surfaces
 (*a*) Primed
 (*b*) Grained to imitate wood
3. Work to be done
 (*a*) Doors
 (*b*) General trim
 (*c*) Hardware
4. Cutting and fitting
5. Underwriters' requirements

(*e*) Tin-covered doors
1. Materials
 (*a*) Tin
 (*b*) Sheet-steel, corrugated
 (*c*) Steel plates
 (*d*) Wood for cores
 (*f*) Underwriter's requirements
 (*g*) Hardware
6. Carpentry
 (*a*) General conditions
 (*b*) Scope of work
 (*c*) Cutting and fitting
 (*d*) Protection of work
 (*e*) Work for other trades
 (*f*) Removing rubbish
 (*g*) Temporary construction
 1. Temporary stairs
 2. Enclosing building
 3. Centering
 4. Forms
 5. Scaffolding
 6. Fences
 7. Sheds and sidewalks
 8. Sidewalk bridge
 (*h*) Materials
 1. Kinds of timber
 2. Grades of timber
 3. Sizes of timber

6.1. Structural framing
 (*a*) Types of buildings
 (*b*) Systems of framing
 (*c*) Work to be done
 1. Girders, joists, floor, and roof
 (*a*) Stirrups, hangers, anchors, straps, etc.
 (*b*) Column caps and bases
 (*c*) Wall boxes, bearing plates, fire cuts
 (*d*) Bridging
 2. Studding
 3. Plates
 4. Rafters
 5. Posts and columns
 6. Framing around openings and chimneys
 7. Temporary bracing
 8. Trusses

9. Rough bucks
10. Grounds, plaster, for trim
11. Furring
12. Nailing strips and wood blocks
13. Under flooring
14. Roof and deck sheathing
15. Battens for slate or tile roofs
16. Special framing for dormers, projecting eaves, gables, and cornices
17. Partition framing
 (*a*) Insulation
 (*b*) Bearing partitions
 (*c*) Trussed openings
 (*d*) Bridging
 (*e*) Sliding-door pockets
18. Sheathing, wall
 (*a*) Building paper
19. Sleepers
 (*a*) Anchors for
20. Miscellaneous rough work

6.2. Exterior Woodwork

(*a*) Materials
1. Woods
2. Grades
3. Sizes
4. Construction
 (*a*) Conform to drawings and details

(*b*) Work to be done
1. Water-table
2. Corner boards
3. Columns and pilasters
4. Cornices
 (*a*) Blocking
 (*b*) Brackets
 (*c*) Plancher
 (*d*) Soffit
 (*e*) Fascia
 (*f*) Moldings
 (*g*) Dentils
 (*h*) Gutters
 (*i*) Flashing
5. Belt courses
6. Half-timber work
7. Panels
8. Gables
9. Siding
10. Porches and piazzas
 (*a*) Cornices
 (*b*) Columns
 (*c*) Railings
 (*d*) Floors
 (*e*) Steps
11. Sun parlors, or porches
12. Windows
 (*a*) Construction of frames
 1. Sills, pulley stiles, pendulums
 2. Provision for pulleys, weights, cord, and chains
 3. Priming before delivery
 4. Setting and anchoring
 5. Brick mold left loose for calking
 6. Calking and weather-stripping
 7. Protection of sills, stiles, and jambs
 (*b*) Types of windows
 1. Double-hung
 (*a*) Mullion
 (*b*) Box frame
 2. Casement
 3. Pivoted
 4. Fixed
 5. Dormer
 6. Stock designs
 (*c*) Sash, blinds, and shutters
 1. Kinds of wood
 2. Sizes and thicknesses
 3. Plowed for cord or chain
 4. Storm sash
 5. Blinds
 6. Shutters
 7. Sash weights
 (*d*) Trim (Window)
 1. Sizes and thicknesses

2. Styles of trim
13. Door frames
(*a*) Construction of frames
1. Thickness
2. Rabbetted
3. Planted stops
4. Priming before delivery
5. Setting and anchoring
6. Windowstops and joggles
7. Block up for hardware
8. Protection during construction
(*b*) Transoms
(*c*) Outside trim
1. Sizes and thicknesses
2. Style
14. Doors (See 6.3)
15. Balconies and railings
16. Curved work
17. Carved work
18. Compo work
19. Lattices and trellises
20. Pergolas
21. Store fronts
(*a*) Bulkheads
22. Fences and gates
23. Flower boxes

6.3. Carpentry (Interior Woodwork)
(*a*) Materials
1. Kinds of wood
(*a*) Seasoned and kiln-dried
2. Grades
3. Sizes
4. Construction
(*a*) Conform to drawings
5. Measurements
(*a*) Taken at building
6. Preparation for finishing
(*a*) Sanding
(*b*) Smoothing
(*c*) Cleaning
7. Back painting
(*a*) Paint before delivery
(*b*) Work to be done
1. Door frames
(*a*) Rabbeted
(*b*) Loose moldings
(*c*) Blocking
(*d*) Setting and anchoring
(*e*) Saddles
2. Doors
(*a*) Batten doors
(*b*) Paneled doors
1. 5-ply panel
2. Solid panel
(*c*) Dutch door
(*d*) Double-swing doors
(*e*) Folding doors
(*f*) Sash doors
(*g*) Sliding doors
(*h*) Accordion doors
(*i*) Counter-balanced doors
(*j*) Lifting doors
(*k*) Revolving doors
(*l*) Slat doors
(*m*) Dumbwaiter doors
(*n*) Cut-out box doors
(*o*) Clothes chute doors
(*p*) Baize, or leather-covered doors
(*q*) Screen doors
(*r*) Secret doors
(*s*) Construction of doors
1. Solid
2. Stock
3. Veneered
4. Stuck moldings
5. Loose moldings
6. Astragals
3. Door and window trim
(*a*) Casings
(*b*) Heads
(*c*) Blocks
(*d*) Plinths
(*e*) Pilasters
(*f*) Columns
(*g*) Cornices
(*h*) False jambs
(*i*) Panel backs
(*j*) Hollow back

(k) Stops
4. Screens
5. Base
(a) Molded
(b) Shoe mold
(c) Cap mold
6. Inside blinds or shutters
(a) Hinged
(b) Sliding
(c) Revolving
(d) Venetian
7. Wainscotings
(a) Cap
1. Molded
2. Plain
(b) Panels
1. 5-ply
2. Veneered
(c) Matched dado
1. V-Jointed
2. Beaded
(d) Base
1. Molded
2. Shoe mold
8. Chair rail
(a) Plain
(b) Molded
9. Picture molding
(a) To contain wires
10. Plate rail
11. Cornices
(a) Molded
(b) Dentils
(c) Compo ornament
(d) Panels
(e) Brackets
12. Ceiling finish
(a) Wood ceiling
1. Matched
(a) V-Joint
(b) Beaded
2. Paneled
(b) False beams
1. Plain
2. Molded
13. Mantels
(a) Over-mantels
14. Book-cases
(a) Built-in
(b) Adjustable shelves
(c) Panel doors
(d) Glass doors
15. China closets
16. Wooden partitions
(a) Toilet
(b) Flexible
(c) Folding
(d) Rolling
(e) Sliding
(f) Glazed
17. Sash
(a) Under skylights
1. Fixed
2. Hinged
(b) In partitions
1. Fixed
2. Hinged
18. Arches
19. Seats
20. Sideboards
21. Closets
(a) Bedroom
(b) Linen
(c) Sewing room
(d) Bath room
(e) Medicine
(f) Cedar
(g) Broom
(h) Table leaf
(i) Coat
(j) Shelving
(k) Coat-and-hat hook strips
22. Pantries
(a) Butler's
(b) Kitchen
(c) Dressers
(d) Counter shelves
(e) Drawers
(f) Adjustable shelves
(g) Drain boards
(h) Refrigerators

1. Built-in
2. Ice door

23. Stairs
(*a*) Kinds
(*b*) Materials
(*c*) Construction of stairs
1. Carriages
2. Strings
(*a*) Open
(*b*) Closed
3. Treads and risers
(*a*) Housed to strings
(*b*) Wedged and glued
(*c*) Blocked
4. Hand rail
5. Balusters
6. Newels
7. Safety treads
8. Paneling under stairs
9. Rear stairs
10. Outside stairs
11. Attic stairs

24. Store fronts
(*a*) Bulkheads

25. Telephone booths

26. Kitchen fittings
(*a*) Dresser
(*b*) Closet
(*c*) Refrigerator
(*d*) Ice door
(*e*) Shelving
(*f*) Drip-boards
(*g*) Casing plumbing pipes

27. Compo ornament

28. Carving

29. Miscellaneous items

(*c*) Shop workmanship
1. Joints
2. Miters
3. Rabbets
4. End grain

(*d*) Inspection

(*e*) Delivery and storage

(*f*) Installation of work
1. Grounds, plugs, etc.
2. Cutting and fitting
3. Scribing
4. Concealed fastenings

6.4. Flooring
(*a*) Materials
1. Kinds of woods
(*a*) White oak
(*b*) Red oak
(*c*) Maple, beech, and birch
(*d*) Yellow pine
(*e*) Norway pine
2. Grades of woods
3. Manufacturing
(*a*) Hollow back
(*b*) End joints
(*c*) Kiln drying

(*b*) Preparation for laying floors
1. Sleepers
2. Insulation and deadening
3. Floor lining, felt, and paper
4. Damp-proofing

(*c*) Laying floor
1. Tongued and grooved
2. Plowed and splined
3. Breaking joints
4. Blind nailing
5. Visible nailing
6. Pockets
7. Planing, scraping, and sanding
8. Protecting

(*d*) Work to be done
1. Woods for different rooms
2. Parquet flooring
(*a*) Hardwood borders
3. Wood-block flooring
4. Cork-tile flooring
5. Rubber-tile flooring

(*e*) Guarantee

6.5. Roofing
(*a*) Scope of work
1. Roof surfaces
2. Gutters, leaders, and flashings

(*b*) Preliminary examination
1. Ready for roofing
2. Report defects to architect

(*c*) Warranty
(*d*) Canvas roofing
1. Scope of work
2. Canvas
(*a*) Weight per yard
3. Nails
(*a*) Copper or galvanized
4. Laying
5. Painting
6. Flashing
7. Guarantee
(*e*) Wood-shingle roofing
1. Scope of work
2. Kind of wood
3. Dipped or stained
4. Size and thickness of shingles
5. Exposure to weather
6. Nails
(*a*) Galvanized or copper
(*b*) Cut iron
7. Finish of hips, valleys, and ridges
8. Flashings
9. Guarantee
(*f*) Asphalt-shingle roofing
1. Scope of work
2. Kind of shingle
3. Pattern
4. Size and thickness
5. Exposure to weather
6. Nails
(*a*) Galvanized or copper
7. Finish of hips, valleys, and ridges
8. Guarantee
(*g*) Metal shingles and tiles
1. Scope of work
2. Kind of shingles or tile
(*a*) Tin
(*b*) Zinc
(*c*) Copper
3. Style
(*a*) Flat
(*b*) Embossed
(*c*) Imitation til
4. Size and thickness of metal
5. Lap and lock
6. Nails
(*a*) Galvanized or copper
7. Finish of hips, valleys, and ridges
8. Flashings
9. Guarantee
(*h*) Asbestos shingles
1. Scope of work
2. Type of shingles
(*a*) Flat or shingle
(*b*) Diagonal, French, or honeycomb
(*c*) Size and thickness
(*d*) Color
3. Nails and fastenings
4. Finish of hips, valleys, and ridges
5. Flashings
6. Cementing
7. Guarantee
(*i*) Slate roofing
1. Scope of work
2. On boards or battens
3. Paper or felt
4. Brand of slate
(*a*) Size
(*b*) Color
(*c*) Thickness
5. Exposure
6. Ornamental or fancy butts
7. Method of laying
(*a*) Regular
(*b*) Old English graduated
8. Nailing
(*a*) Copper or galvanized nails
9. Finish of hips, valleys, and ridges
10. Cementing
11. Flashing
12. Guarantee
(*j*) Tile roofing
1. Scope of work
2. On boards or battens
3. Paper or felt

4. Types of tile
 (*a*) Shingle
 (*b*) Spanish
 (*c*) Mission
 (*d*) Roman
 (*e*) Interlocking
 (*f*) Cement tiles
5. Special tiles
 (*a*) Eaves starters
 (*b*) Gable ends
 (*c*) Hips
 (*d*) Valleys
 (*e*) Ridges
 (*f*) Finials
6. Methods of fastening
 (*a*) Copper nails
 (*b*) Galvanized-iron nails
 (*c*) Yellow metal nails
 (*d*) Copper wire
7. Finish of hips, valleys, and ridges
8. Cementing
9. Guarantee

(*k*) Tin roofing
1. Scope of work
2. Type of roofing
 (*a*) Flat seam
 (*b*) Standing seam
 (*c*) Ribbed
3. Materials
 (*a*) Quality of tin
 (*b*) Coating
 (*c*) Thickness
 (*d*) Size of sheets
 (*e*) Solder
 (*f*) Flux, rosin only
4. Laying
 (*a*) Cleats
 (*b*) Nailed through edge
 (*c*) Felt
5. Preparation before laying
 (*a*) Paint under side
6. Finish of hips, valleys, and ridges
7. Flashings and counter-flashings
8. Unnecessary walking on roof not allowed
9. Cleaning on completion
10. Painting
11. Guarantee

(*l*) Copper roofing
1. Scope of work
2. Types of roofs
 (*a*) Flat seam
 (*b*) Standing seam
 (*c*) Ribbed
3. Materials
 (*a*) Gauge and metal
 (*b*) Size of sheets
 (*c*) Solder
 1. Half-and-half
 (*d*) Flux
 1. Cut acid
4. Laying copper roofing
 (*a*) Cleats
 (*b*) Nailed through edges
 (*c*) Felt
 (*d*) Expansion joints
5. Preparation before laying
 (*a*) Edges tinned
6. Finish of hips, valleys, and ridges
7. Flashing and counter-flashing
8. Unnecessary walking on roof
 (*a*) Not allowed
9. Cleaning on completion
10. Guarantee

(*m*) Roll, or prepared roofing
1. Scope of work
2. Type of roofing
 (*a*) Number of plies
 (*b*) Slate chip surface
 (*c*) Asphalt surface
3. Laying
 (*a*) Horizontal strips
 (*b*) Vertical strips
 (*c*) Copper or galvanized nails
 (*d*) Caps or cleats

(*e*) Cementing sheets together
4. Finish at eaves, gable ends, hips, valleys, and ridges
5. Flashing
6. Guarantee
(*n*) Composition roofing
1. Scope of work
2. Foundation or roof surface
(*a*) Boards
(*b*) Concrete
3. Building paper (Over boards)
4. Number of layers of felt
(*a*) 3-ply
(*b*) 4-ply
(*c*) 5-ply
5. Weight of felt per square
6. Weight of tar or asphalt per square
7. Method of laying
8. Nailing
9. Finish
(*a*) Coating of tar or asphalt
(*b*) Coating of gravel or slag
(*c*) Amount of gravel or slag per square
(*d*) Promenade tiles or brick
10. Flashing
(*a*) Raggle blocks
11. Inspection and guarantee
6.6. Miscellaneous Carpentry
(*a*) Arbors
(*b*) Bins
(*c*) Bulkheads
(*d*) Clothes chutes
(*e*) Clothes posts
(*f*) Cold air duct
(*g*) Conservatory
(*h*) Dumbwaiter
(*i*) Fence
(*j*) Flagstaff
(*k*) Flower boxes
(*l*) Garden accessories
(*m*) Gates
(*n*) Insulation and sheathing
(*o*) Screens
(*p*) Shelving
(*q*) Storm vestibules
(*r*) Summer houses
(*s*) Tanks
(*t*) Walks
(*u*) Wood sheds
6.7. Hardware
(*a*) Rough hardware
1. Nails, screws, and screw bolts
2. Sash weights
(*a*) Iron
(*b*) Lead
(*c*) Sectional
3. Window pulleys
(*a*) Side pulleys
(*b*) Overhead pulleys
(*c*) Spring balances
4. Sash chain, cords, and ribbons
5. Sliding-door hardware
(*a*) Elevator doors
(*b*) Fire doors
6. Underwriters' standard door hardware
(*b*) Finishing hardware
1. Hardware furnished by owner
2. Provisional amount for hardware
3. Hardware required
(*a*) List
(*b*) Manufacturers' numbers
4. Materials and finish
(*a*) Kinds of materials
1. Brass
2. Bronze
3. Copper
4. Iron
(*a*) Cast
(*b*) Wrought
5. Texture of surface
6. Color of surface
7. List of hardware required

(*a*) Awnings
(*b*) Closets, etc.
(*c*) Bathroom accessories
(*d*) Doors
(*e*) Gates
(*f*) Miscellaneous
(*g*) Sash
(*h*) Shutters and blinds
(*i*) Window - cleaning devices
(*j*) Adjusters, sash
(*k*) Baggage hooks
(*l*) Bars
(*m*) Bells
(*n*) Bolt plates and staples
(*o*) Bolts, Panic
(*p*) Boxes for floor spring hinges
(*q*) Brackets
(*r*) Buttons
(*s*) Butts
(*t*) Card plates
(*u*) Casement hardware
(*v*) Casters
(*w*) Catches
(*x*) Ceiling hooks
(*y*) Chains
(*z*) Check and spring, door
(*A*) Cleats, Line
(*B*) Cord
(*C*) Cupboard catches and turns
(*D*) Curtain pins
(*E*) Door hardware
(*F*) Drawer hardware
(*G*) Druggist drawer pulls and labels
(*H*) Escutcheons
(*I*) Fasteners
(*J*) Figures
(*K*) Floor plates
(*L*) Finger plates
(*M*) Grips
(*N*) Handles
(*O*) Brackets
(*P*) Hangers
(*Q*) Hinges
(*R*) Hooks
(*S*) Knobs
(*T*) Latches
(*U*) Letter-boxes
(*V*) Lifts
(*W*) Lock sets
(*X*) Plates
(*Y*) Pulleys
(*Z*) Pulls and escutcheons
(*aa*) Rings
(*bb*) Rollers
(*cc*) Sash hardware
(*dd*) Screen hardware
(*ee*) Sheaves
(*ff*) Skylight hardware
(*gg*) Sockets
(*hh*) Special door hardware
(*ii*) Springs
(*jj*) Stays
(*kk*) Stops and holders
(*ll*) Strikes
(*mm*) Transom hardware
(*nn*) Turnbuckle and extension bolts

7. Painting
 (*a*) General conditions
 (*b*) Scope of work
 (*c*) Inspection of work
 1. Notify architect of faulty work
 (*d*) Preparation
 1. Cleaning
 2. Setting nails
 3. Putty and sandpapering
 4. Shellac knots and sap
 5. Lime knots and sap
 (*e*) Samples
 (*f*) Work in freezing weather
 (*g*) Protection
 (*h*) Materials

1. Quality and kind to be approved
2. Delivery in original packages
3. Mixing at the building
4. Use without thinning or addition
5. White lead
6. Red lead
7. Linseed oil, raw, boiled
8. Turpentine
9. Oil colors
10. Driers
11. Graphite
12. Zinc white
13. Enamels
14. Dry colors
15. Cement paints
16. Distemper colors
17. Varnish
 - (*a*) For exterior work
 1. Spar
 2. Floor
 - (*b*) For interior work
18. Fillers
 - (*a*) Liquid
 - (*b*) Paste
19. Shellac
 - (*a*) White
 - (*b*) Orange
20. Putty
21. Wax
22. Floor finish
23. Stains
 - (*a*) Acids
 - (*b*) Water
 - (*c*) Spirit
 - (*d*) Oil
 - (*e*) Interior
 - (*f*) Shingle
24. Paint removers
25. Waterproof paints
26. Special paints
 - (*a*) Aluminum
 - (*b*) Asphalt
 - (*c*) Blackboard
 - (*d*) Bronze
 - (*e*) Damp-proof
 - (*f*) Fire resisting
 - (*g*) Masonry paints
 - (*h*) Metallic paints
 - (*i*) Non-staining paints
 - (*j*) Ready-mixed paints
 - (*k*) Steel and iron paints

(*i*) Priming

1. Before material leaves shop
2. Back painting
3. Priming exterior work
4. Priming backs of hardwood finish
5. Staining and filling hardwood

(*j*) Work to be done

1. Finishing floors
2. Finishing hardwood
 - (*a*) Cleaning
 - (*b*) Sandpapering
 - (*c*) Painting work against masonry
 - (*d*) Puttying after first coat
 - (*e*) Coloring putty
 - (*f*) Kinds of finish
 1. Dull
 2. Eggshell gloss
 3. Flat
 4. Polished
 5. Elastic
 6. Enamel
 7. For soft woods in natural state
 8. Exterior finish required

(*k*) Painted work

1. Number of coats

(*l*) Metal work

1. Cleaning
2. Work not included
 - (*a*) Tin roof, etc.
3. Work included
 - (*a*) Structural and ornamental work
 1. Exterior
 2. Interior

(*b*) Exposed piping, metal ducts, pipe covers, etc.
(*c*) Elevator sheave beams, guides, etc.
(*d*) Fire escapes, outside steps
(*e*) Elevator fronts, ornamental grilles
(*f*) slop sink standards
(*g*) Other metal work against masonry floors
(*m*) Kinds of paint
1. Lead and oil paints
2. Waterproof paints
3. Enamel paints
4. Smoke-resisting paints
5. Water-resisting paints
6. Acid-proof paints
7. Special paints
(*n*) Number of coats
(*o*) Sheet metal
1. Cleaning, with benzine
2. Number of coats
3. Oiling, copper, etc.
4. Painting roof
(*p*) Wood, painted work
1. Number of coats
2. Painting exterior work
3. Staining exterior work
4. Special finishes
5. Party colors
6. Ivory whites
7. Enamel whites
(*q*) Graining
(*r*) Miscellaneous painted work
1. China closet
2. Lettering names and numbers
3. Composition ornament
4. Bronzing radiators, etc.
5. Painting canvas covers on pipes
(*s*) Stained work
1. Exterior
(*a*) Shingles
(*b*) Woodwork
2. Interior
(*a*) Woodwork
(*t*) Masonry walls
1. Cleaning
2. Painting
(*a*) Brand or make
3. Kinds of finish
(*a*) Lead and oil
(*b*) Masonry coatings
(*c*) Waterproof paints
(*d*) Calcimine
(*e*) Mill white
(*f*) Patented coatings
(*u*) Plastered walls
1. Stenciling walls
2. Decorating walls
3. Stipple finish
4. Graining walls to imitate stone
(*v*) Stucco walls
1. Waterproof paint
(*w*) Application of materials
7.2. Decorating
(*a*) Scope of work
(*b*) Materials
1. Paper
2. Cloth
3. Sanitas
4. Other special materials
5. Gold leaf
6. Cold-water paints or tints
7. Panel moldings
(*c*) Preparation of surfaces to receive decoration
(*d*) Application
(*e*) Retouching and finishing
(*f*) Cleaning
8. Glazing
(*a*) General conditions
(*b*) Scope of work
(*c*) Drawings and designs
(*d*) Samples
(*e*) Kinds of glass
1. Sheet glass
(*a*) Single thick

(*b*) Double thick
(*c*) Crystal
(*d*) Cylindrical
2. Plate glass
(*a*) Thin
(*b*) Thick
(*c*) American
(*d*) French
(*e*) English
(*f*) Crystal
(*g*) Rough cast
3. Prismatic
4. Crown glass
5. Mirrors
6. Stained glass
7. Structural glass
8. Wire glass
9 Non-shattering glass
(*f*). Finish of glass
1. Obscured
2. Colored
3. Figured
4. Ribbed
(*g*) Installing glass
1. Puttying back and face
2. Glazing points
3. Wood beads
4. Clips
5. Loose muntins
6. Leading
7. Patent glazing
8. Backing mirrors
9. Reflecting surfaces of mirror
10. Moldings painted black
11. Cames
(*h*) Where Used
1. Doors
2. Windows
3. Mirrors
4. Pavement lights
5. Show windows
6. Skylights
7. Domes
8. Roof tiles
(*i*) Protection of glass
(*j*) Plate-glass insurance
(*k*) Glass breakage and replacement
(*l*) Cleaning
9. Plumbing
(*a*) General conditions
(*b*) Scope of work
(*c*) Laws and ordinances
1. Obtain permits
2. Pay fees
3. Give proper notices
4. Testing and inspection
(*a*) Work to be tested
(*b*) Time for testing
(*c*) Water test
(*d*) Air test
(*e*) Peppermint test
(*f*) Hydraulic test
(*g*) Smoke test
(*h*) Sulphur test
(*d*) Materials
1. Cast-iron pipe and fittings
(*a*) Sizes and weights of pipe
(*b*) Sizes and weights of fittings
(*c*) Y's, bends, branches, etc.
(*d*) Pipe marked with manufacturer's name
(*e*) Pipe coated after testing
(*f*) Joints calked
2. Wrought-iron pipe and fittings
(*a*) Mild steel
(*b*) Genuine puddled wrought iron
(*c*) Galvanized pipe
3. Lead pipe
(*a*) Sizes and weights
(*b*) Lugs
(*c*) Ferrules and sleeves
4. Brass pipe and fittings
(*a*) Nickel-plated
5. Block-tin pipe
6. Tin-lined pipe
7. Earthenware pipe and fittings
8. Vitrified tile and fittings

9. Solder
10. Pig lead
11. Oakum

(*e*) Trenches
1. Excavation
2. Grading
3. Filling
4. For water pipes
5. For sewer pipes
6. For gas

(*f*) Drainage system
1. House sewer
2. House drain
3. Soil, vent, and waste stacks
4. Floor drains and traps
 (*a*) Strainer over
5. Area drains and traps
6. Fresh air inlet
7. Leaders and leader traps
8. House trap
9. Back-water trap
10. Grease trap
11. Steam blow-off connection
12. Cleanouts
 (*a*) At base of all vertical lines
 (*b*) Where required to clean system
13. Drainage receptacles
 (*a*) Cess-pools
 (*b*) Sumps
 1. Sewage ejectors
 (*c*) Catch basins
 (*d*) Cisterns
 (*e*) Manholes
14. General rules for installation
 (*a*) Vertical pipes plumb
 (*b*) Horizontal pipe uniform fall
 (*c*) Supports for pipes
 1. Adjustable hangers
 2. Brick piers
 3. Clamps
 4. Other supports
 (*d*) Fittings
 1. Sizes of Y's, bends, and branches
 2. Reducer fittings
 (*e*) Protection of pipes from siphonage
 (*f*) Ventilation of drainage system
 (*g*) Collars, sleeves, and plates through walls
 (*h*) Flashings
 1. Pipes through roof
 (*i*) Expansion and contraction
 1. Horizontal lines
 2. Vertical lines
 (*j*) Hoods for pipes through roof
 (*k*) Disposal of sewage
 1. Municipal sewage system
 2. Private sewage system
 (*l*) Roughing-in and connections
 (*m*) Valves

(*g*) Water-supply system
1. Source of supply
 (*a*) Street connection
 (*b*) Wells
 (*c*) Cistern
 (*d*) Storage tanks
2. Meter and fish trap
3. Filters
4. House pump
5. Roof tank
6. Mains, risers, branches, etc.
 (*a*) Supply to boilers
 (*b*) Supply to feed water heaters
 (*c*) Supply to hydraulic elevators
 (*d*) Supply to laundry machinery
 (*e*) Supply to kitchen and cooking apparatus
 (*f*) Auxiliary water heater
 (*g*) Hot-water tank

(*h*) Ventilating apparatus
7. Hot Water supply
(*a*) Heater
(*b*) Water backs
(*c*) Coil at furnace
(*d*) Circulating pipes
(*e*) Stop and waste cocks
8. Fire lines
9. Line to hose connection, street washing, etc.
10. Drains and drain cocks
11. Supporting pipes
12. Provision for expansion and contraction
13. Piping
(*a*) Exposed
(*b*) Concealed
14. Valves
(*a*) Gate
(*b*) Pressure-reducing
(*c*) Main supply and return lines
(*d*) Other supply lines
(*e*) Drip valves
(*f*) Branches supplying each floor
15. Pipe covering
16. Fire stand-pipe system
17. Painting pipes
(*a*) Where necessary

9.1. Plumbing Fixtures
(*a*) Schedule of fixtures
(*b*) Locate where shown on plans
(*c*) Set true and plumb
(*d*) Fasten securely in place
(*e*) Fill openings behind fixtures
(*f*) Samples
(*g*) Description of fixtures
1. Designate by trade-names
(*a*) Baths
1. Shower
2. Rain
3. Needle
4. Built-in
(*b*) Water closets
1. Type
2. Material
3. Finish
(*c*) Tanks
1. Type
2. Material
3. Finish
(*d*) Urinals
1. Type
2. Material
3. Fittings
4. Tank
(*e*) Drinking fountain
(*f*) Foot baths
(*g*) Laundry tubs
1. Type
2. Material
3. Fittings
(*h*) Lavoratories
1. Type
2. Material
3. Fittings
(*i*) Range
1. Portable
2. Built-in
3. Water-back
4. Gas
5. Combination
(*j*) Sinks
1. Types
2. Material
3. Fittings
(*k*) Toilet room accessories
(*l*) Safes
(*m*) Guarantee

9.2. Gas-Fitting
(*a*) Source of supply
1. Street connection
2. Private plant
(*b*) Fuel or lighting gas
(*c*) Meter
(*d*) Materials for piping
1. Black iron pipe
2. Galvanized pipe
(*e*) Protecting pipes from frost
(*f*) Branches to fixtures
(*g*) Sizes of piping

(*h*) Installation
(*i*) Drainage
(*j*) Securing pipe in place
(*k*) Outlets
(*l*) Supporting fixtures
(*m*) Valves
(*n*) Tests

10. Electric Wiring and Equipment
(*a*) General conditions
(*b*) Scope of work
(*c*) Laws and regulations
1. National Electric Code
2. Insurance requirements
3. Local regulations
(*a*) State
(*b*) Municipal
4. Permits
5. Tests
(*a*) Mechanical
(*b*) Chemical
(*c*) Electrical
6. Certificate of inspection
(*d*) Drawings and diagrams
1. Symbols
(*e*) Current
1. Alternating
(*a*) Voltage
2. Direct
(*a*) Voltage
3. Transformers
4. Private plant
5. Municipal plant
6. Service switch
7. Loss of potential
8. Grounding
9. Systems of metering
10. Systems of distribution
(*a*) Two-wire
(*b*) Three-wire
(*f*) Switchboard
1. Location
2. Construction of framework
3. Material of switchboard
(*a*) Marble
(*b*) Slate
4. Thickness
5. Apparatus on switchboard
(*a*) Switches
(*b*) Meters
(*c*) Current - recording gauges
(*d*) current-breakers
(*e*) Fuses
1. Duplicate fuses
(*f*) Name plates
(*g*) Rubber mat
(*h*) Grill and doors
(*g*) Conduits
1. Rigid
(*a*) Pipe
(*b*) Metal molding
(*c*) Wooden molding
2. Flexible
(*a*) Armored
(*b*) Circular loom
3. Conduits for exterior outlets
4. Continuous between junction boxes
5. Six-inch turns
6. Kinds, size, and thickness
7. Four quarter-turns in run
8. Ream out burrs
9. Underground conduit
(*a*) Excavating
(*b*) Filling
(*h*) Cabinets and panels
1. Slate back
2. Finish of metal
3. Fuses
(*a*) Types
(*b*) Schedule
4. Switches
(*a*) Knife
(*b*) Safety
(*i*) Boxes and outlets
1. Location
2. Types of boxes
3. Switch boxes
4. Distribution boxes
(*a*) Marking circuits
5. Cut-out boxes

6. Junction boxes
7. Outlet boxes
8. Fittings
9. Fixture supports
10. Combination boxes for gas and electric

(*j*) Wires and cables
1. Kind and make
 (*a*) Insulated
 (*b*) Stranded
 (*c*) Cord
 (*d*) Twisted pairs
 (*e*) Gauge or size
 (*f*) Insulation
2. Feeders and subfeeders
 (*a*) Power feeders to machinery
 (*b*) Elevator feeders
 (*c*) Pump feeders
 (*d*) Ventilating machinery feeders
 (*e*) Conveying and hoisting machinery
 (*f*) Welding and forging
 (*g*) Motors
3. Individual circuits
 (*a*) Electric lights
 (*b*) Electric signs
 (*c*) Exit emergency lights
4. Taping ends of wires
5. No splice between outlets
6. Underground, lead-covered
7. Systems of wiring
 (*a*) Two-wire
 (*b*) Three-wire

(*k*) Switches
1. Knife
2. Snap
3. Indicating
4. Automatic circuit-breaker
5. Fused switch
6. Safety-first lever switch
7. Push button
8. Rotary switch
9. Toggle switch
10. Receptacle or exterior
11. Pendent
12. Pull
13. Canopy
14. Three-way
15. Four-way
16. Remote control
17. Door
18. Master
19. Tandem push
20. Gang
21. Key snap

(*l*) Fuses
1. Wire
2. Plug
3. Renewable
4. Open or link
5. Cartridge

(*m*) Receptacles
1. Base
2. Floor
3. Ceiling
4. Side
5. Drop cord

(*n*) Miscellaneous wiring systems
1. Conduit or open wiring
2. Transformers
3. Door bells
4. Door openers
5. Call bells
 (*a*) Domestic systems
 (*b*) Hotels
 (*c*) List of stations
 (*d*) Kind of bells
 (*e*) Annunciators
6. Burglar alarms
 (*a*) Type and installation
7. Fire-alarm systems
 (*a*) Type of system
 (*b*) Wiring
 (*c*) Connected to city department
 (*d*) Local fire-alarm system
 (*e*) Location of boxes
 (*f*) Location and type of gongs
8. Clock systems

(a) Master clock
(b) Secondary clocks
(c) Batteries
(d) Distributing board
(e) Push-button board
(f) Bells and gongs
(g) Time clock
(h) Watchman's time recorder
(i) Program machine

9. Systems requiring conduit only
(a) Telephone
(b) Telegraph
(c) Messenger service

11. Heating
(a) General conditions
(b) Scope of work
(c) Drawings
(d) Cutting and patching
(e) Warranty
1. Certain temperature in zero weather
2. Perfect circulation
3. For term of years
(f) Tests
(g) Assured by approved company
(h) Certificate of inspection
(i) Heating systems
1. Steam
(a) Direct
(b) Indirect
(c) Vacuum
(d) Exhaust
(e) Central plant
(f) One-pipe
(g) Two-pipe
2. Hot water
(a) Direct
(b) Indirect
3. Hot air
(j) Steam heating
1. High pressure
2. Low pressure
3. Boilers
(a) Make
(b) Maximum pressure
(c) Horse power
(d) Heating surface
(e) Steel
(f) Cast iron
(g) Mason's work
1. Setting
2. Firebrick
(h) Smoke connections
(i) Breeching
(j) Blowing-off system
(k) Blow-off cock
(l) Steam gauge
(m) Fusible plug
(n) Automatic low-water alarm
(o) Injector
(p) Feed-water heater
(q) Steam coil to hot-water tank

4. Piping
(a) Make and weight
(b) Wrought iron
(c) Galvanized
(d) Sizes of mains and branches
(e) Provision for expansion and contraction
(f) Grading to mains
(g) Drips
(h) Hangers and supports
(i) Sleeves and plates

5. Valves
(a) Gate
(b) Globe
(c) Radiator
(d) Air line
(e) Safety
(f) Pressure reducing
(g) Vent

6. Radiators
(a) Direct
(b) Indirect
(c) Direct-indirect
(d) Schedule of radiation

(*e*) Type and make
(*f*) Radiator covers and deflectors
7. Coverings, non-conductors
(*a*) Magnesia blocks
(*b*) Magnesia cement
(*c*) Asbestocel
(*d*) Canvas jackets
(*e*) Lacquered tin bands
8. Trench and pipe covers
9. Adjustment of system
10. Fire tools and miscellaneous tools
11. Ash hoist
12. Automatic temperature regulator
13. Painting and bronzing
(*k*) Hot-water heating
1. Boiler (See 11-(*j*)-3)
2. Piping (See 11-(*j*)-4)
3. Valves (See 11-(*j*)-5)
4. Radiators (See 11-(*j*)-6)
5. Coverings (See 11-(*j*)-7)
6. Adjustment of system (See 11-(*j*)-9)
7. Fire tools, etc. (See 10-(*j*)-10)
8. Ash hoist (See 11-(*j*)11)
9. Automatic temperature regulator
10. Painting and bronzing (See 11-(*j*)-13)
11. Expansion tank
12. Garbage incinerator
(*l*) Hot air heating
1. Furnaces
(*a*) Size, make, etc.
(*b*) Material of furnace and casing
(*c*) Flues
(*d*) Cold-air box
(*e*) Registers
(*f*) Covering, (See also 11-(*j*)-7)
(*g*) Painting and bronzing (See 11-(*j*)-13)
(*m*) Temporary heating
12. Ventilating
(*a*) General conditions
(*b*) Scope of work
1. Cubic feet of air per minute
2. Cubic feet of vitiated air removed
(*c*) Drawings
(*d*) Cutting and patching
(*e*) Warranty
(*f*) Kind of system
1. Natural or gravity system
2. Vacuum of exhaust system
3. Plenum system
(*g*) Tempering coils
(*h*) Reheating
(*i*) Air moistening
(*j*) Purifying
1. Filtering
2. Cheesecloth
(*k*) Fans
1. Make, etc.
2. Location
3. Foundation
(*l*) Motors
1. Make, etc.
2. Wiring
3. Noiseless operation
(*m*) Thermostats
1. Temperature regulation
(*n*) Ducts
1. Valves
2. Bends
3. Supports
(*o*) Registers
1. Grilles
2. Deflectors
3. Screens
(*p*) Testing and adjusting
(*q*) Painting
13. Miscellaneous Items
(*a*) Mail chute
1. Type
2. Construction
(*b*) Dumbwaiters
1. Type

2. Travel
3. Lift (Capacity)
4. Control

(*c*) Elevators

1. Type
2. Travel
3. Lift
4. Signals
5. Control
6. Safety devices
7. Tests
8. Warranty

(*d*) Clothes chutes

1. Size
2. Construction

(*e*) Package chutes

(*f*) Conveyers

In the papers entitled "Reading Architects' Blueprints," reference is made to a set of ten blueprints. In this book the blueprints are reproduced in reduced size in black, and the set will be found grouped following the papers entitled "Specification Writing."

SPECIFICATION WRITING
(PART 2)

EXAMPLES OF A SPECIFICATION

1. In this Section a set of specifications will be given. These specifications will describe the workmanship and materials necessary for the completion of the private residence, the plans, elevations, and sections of which are contained in this Section. The blueprints given with the papers on *Reading Architects' Blueprints* and *Architectural Drawing* are similar to the drawings in this Section. Either the drawings or the blueprints may be consulted when the drawings of the residence are referred to in this Section. The drawings are at a scale of $\frac{1}{8}$ inch equals 1 foot, and the blueprints show the same plans at a scale of $\frac{1}{4}$ inch equals 1 foot. The latter scale is the one customarily used in the preparation of working drawings.

2. Each type of building calls for a different specification, but the same general method of specifying is applicable to all buildings. With a good understanding of the following specification, a person should have little or no difficulty in understanding any other similar specification, and should have a good knowledge of how to specify any kind of work or material found in the average building.

3. As a rule, in writing specifications, it is not customary to specify a material, fixture, or device that is manufactured by one manufacturer, when equally good materials or devices are made by several firms. If this is done, it may lead to suspicion on the part of the owner that the architect may benefit personally by so specifying. It may also cause the manufacturer to charge a higher price for his article, since there is no

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competition. Whenever an article is made by several manufacturers, it is best to give a complete description of the article, and allow the bidder to obtain it where he can get it at the lowest price. The architect must exercise his judgment in determining whether or not the article, when supplied for use in the building, meets the requirements of the specifications.

4. There are, however, certain materials, fixtures, or articles that have special or distinctive qualities, and may be specified in connection with the manufacturer's name or from his catalog. For example, bathroom fixtures are generally selected from the catalog of some reputable manufacturer, and are specified from that catalog. In such cases the manufacturer's name, the trade-name of the fixture, the material of which it is constructed, and the size and fittings are all specified as in the following instances:

"One (1) J. L. Mott Company's "Layton" enameled iron 3" roll rim bath, 5' 0" long, painted one coat outside, fitted with nickle-plated "Harlem" compression faucet, nickel-plated "Harlem" $1\frac{3}{8}$" connected waste and overflow, chain and rubber stopper, and $\frac{1}{2}$" iron-pipe size supply pipes. Plate No. 2,683E."

5. In the description just given, the name of the manufacturer, J. L. Mott Company, the name of the bath, "Layton", the name of the faucet "Harlem", and the number of the plate in the catalog, No. 2,683E are given. The fixture is thus completely identified, and the specification is complete.

In specifying switches in connection with electric wiring, the names of two or three manufacturers are sometimes given thus: "Switches shall be either Hubbell, Bryant, or General Electric make."

In specifying a heating boiler, a certain make or kind may be specified as follows: "The contractor shall install in the boiler room where shown on the drawings, one American Radiator Co's "Ideal" S-25-5 (catalog number) sectional cast-iron boiler, 800 sq. ft. of radiation, or Hart & Crouse Company's "Royal" S-22-5 (catalog number) sectional cast-iron boiler, 800 sq. ft. of radiation."

Fireplace throats and dampers are specified, using the manufacturer's name, thus: "Each fireplace shall be provided with

the Covert Improved throat and damper, made by the H. W. Covert Company, New York, N. Y."

The articles in the following specifications are numbered in continuation of the preceding articles in this Section. This has been done for the purpose of ease in referring to the various articles. In an actual specification the first article would be No. 1.

6. In the following specification the work is specified under separate headings. The work under any of the headings may be done under a separate contract. Frequently, however, the work described under several of the headings is grouped under one contract. For example, the work under the headings Excavation, Concrete, Brickwork, Plastering, and Marble and Tile Work may be done by a mason contractor. The work under the headings Carpenter Work, Exterior Finish, Interior Finish, and Hardware, is generally undertaken by a carpenter contractor. In some localities one contractor takes charge of the plumbing, heating, and gas fitting. The contractor for electric work would take care of electric wiring, call bells, and conduits for telephone wires. Painting and Glazing are frequently given to the same contractor, and at times are both given to the carpenter contractor. In very small buildings most of the work is included under one contract. On large buildings the work is more likely to be divided among several contractors. There is no fixed rule regarding the grouping of work under contracts. The matter is generally determined by the size of the building and by local customs.

7. When the work is divided the General Conditions may be attached to the specifications of each class of work, or they may be merely referred to and not attached. They should nevertheless be kept where they can easily be referred to by any of the contractors who are working under them.

8. Title Page.—The title page is shown next. The title page states the nature and location of the building, and the names and addresses of the owner and the architect. Then come the instructions to bidders, and an index to the specifications. The main body of the specification follows.

SPECIFICATIONS

of

LABOR AND MATERIALS

required for the erection of the two-story and attic dwelling to be erected at 15 West Street, in the City of Scranton, Pennsylvania, for

JOHN SMITH, Esq.

in accordance with the accompanying drawings prepared by

James A. Brown

Architect

100 Main St.

Scranton, Pa.

INSTRUCTIONS TO BIDDERS

Submission of Proposals: Proposals to be entitled to consideration must be made in accordance with the following instructions:

Proposals shall be enclosed in an opaque, sealed envelope, addressed to the architect, at his office, marked "Proposal", and bearing the title of the work for which the proposal is made, and the name of the bidder.

No oral, telegraphic, or telephonic proposals or modifications will be considered.

Additional Information: In case a bidder finds discrepancies or omissions in, or is in doubt as to the meaning of, the drawings or documents, he should at once notify the architect, who will forthwith send written instructions to all bidders. Neither owner nor architect will be responsible for any oral instructions.

Inspection of Site: Before submitting proposals, bidders should carefully examine the drawings and specifications, visit the site of the work, fully inform themselves as to all existing conditions and limitations, and shall include in the proposal a sum to cover the cost of all items contemplated by the drawings and documents, and required by the conditions existing on site.

Samples: Each bidder shall submit, with his proposal, samples of the materials which he proposes to use, whenever so required by the specifications.

Competency of Bidders: The competency and responsibility of bidders and of their proposed subcontractors will receive careful consideration in the award.

Right to Reject: The owner does not obligate himself to accept the lowest or any other bid, and may waive any informality in any proposal.

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9. The list of drawings accompanying this specification includes the following:

No. 1.—South Elevation,	¼ inch scale
No. 2.—West Elevation,	¼ inch scale
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10. (Following the list of drawings, the General Conditions should be stated. They may be written to suit the views of the individual architect, or, preferably, a printed set of General Conditions such as those issued by the American Institute of Architects, may be bound in each copy of the specifications at this place.)

SCOPE OF WORK

11. The work to be done includes all of the mason work, including brickwork, stucco, plastering, and tile work; all miscellaneous ironwork, carpenter work, hardware, sheet-metal work, roofing, painting, glazing, plumbing, gas piping, electric wiring, and heating; all as hereinafter described and shown in the accompanying drawings.

EXCAVATION

12. Clearing Site.—The contractor shall clear the site, cut down any trees which interfere with the building operations, and grub up all stumps and roots of trees. All such materials and rubbish shall be removed from the premises.

During the building operations, special care must be taken by the contractor to protect all trees remaining on the property. Those near the building must be boxed with wooden crates.

13. Laying Out Work.—The contractor for the excavation shall lay out the building accurately upon the site, following the marks laid out by the surveyor and shall be responsible for placing the building correctly on the lot.

14. Excavation.—The contractor shall do all the required excavation as shown on the drawings for basement, areas, foundation walls, footings, piers, and so forth. Excavations are to be carried to the depths shown on the drawings. Remove the top soil from the site of the building, and deposit it where directed. Sufficient clean earth shall be kept for filling and grading. The remainder shall be removed from the premises.

15. It is expected that ordinary soil will be met. If rock is encountered, its excavation will be considered as extra work under this contract. The contractor in making his proposal shall include a price per cubic foot or cubic yard for excavating rock. This price will be used as a basis of payment for such work and will be in addition to the regular bid for earth excavation.

16. It may be found necessary to excavate to a greater depth than is shown on the drawings for footings, in order to obtain a firm support. The contractor shall give with his proposal a price per cubic yard for earth excavation that may be required in addition to that shown on the drawings.

17. The bottoms of all excavations are to be left level and smooth, and at the depths shown or directed.

18. This contractor is to provide and use shoring when required to prevent earth from caving into the excavation from either the adjoining yards or from the streets or alley.

19. Should water be encountered during the course of the excavation, this contractor shall keep the excavations clear by pumping and draining away such water.

20. The plumber, electrician, and heating contractor shall do the excavating and refilling necessary for their work at their own expense.

21. Grading and Refilling.—The contractor shall do any and all grading and filling required to obtain the lines shown on the drawings. After the foundation walls are in, and have set, he shall refill next to the outside walls around the building, tamping, and puddling the filling every eight inches in height.

The contractor shall do all filling around walls and piers where concrete floors occur.

He shall fill under floors of the breakfast porch, front porch and side porch to obtain the heights shown on the drawings. The fill shall be thoroughly tamped and puddled in 8-inch layers.

22. Sand.—All sand shall be the best quality of washed bank sand. It shall be sharp, well-graded, free from salt, loam, clay, or

organic matter. It must be properly screened before mixing with cement or lime.

23. The sand for putty mortar for the plastering shall be of the best quality of white sand. It must be washed and screened.

24. Broken Stone.—All broken stone for concrete shall be hard, durable, crushed granite, trap-rock, flint limestone, or a clean gravel. Stone must be clean, in no case containing over one per cent. (1%) of clay or other foreign matter. Stone for plain concrete may have a maximum diameter of 2½ inches. Stone for reinforced concrete shall be ¾ inch in its greatest diameter, and ¼ inch in its smallest diameter. The contractor may, if he so desires, substitute blast-furnace slag for broken stone, in which case it must be a basic furnace slag with a low sulphur content, and approved by the architect.

25. Lime.—All lime shall be fresh, properly burned quicklime, and shall contain not more than 5 per cent. of ashes, core, clinker, or other foreign material, and shall comply with the standards of the American Society for Testing Materials. An approved brand of hydrated lime may be used instead of the quicklime, if so desired.

26. Portland Cement.—All Portland cement shall be of an approved brand, must stand the tests required by the American Society for Testing Materials, and shall have been manufactured at least 30 days prior to shipment.

27. Storage.—All lime and cement must be kept under cover and be stored on planks or skids raised from the ground.

CONCRETE

28. Proportions of Ingredients.—Concrete shall be mixed in the proportions of one part of Portland cement, three parts of sand, and five parts of broken stone, or the approved equivalent. Concrete for reinforced slabs shall be mixed in the proportions of one part of Portland cement, two parts of sand, and four parts of broken stone, or the approved equivalent.

Concrete for foundation walls shall be waterproofed by the addition of 12 pounds of dry hydrated lime to each bag of cement.

29. Mixing Concrete.—Concrete may be mixed either by machine or by hand, but whether mixed by machine or by hand, the resulting concrete shall be of a uniform color and appearance, with the stone thoroughly incorporated in the mortar. The consistency shall be uniform throughout, and all the materials must be measured before putting in the mixer. The concrete shall be mixed wet, so that it

will have to be handled quickly, or it would run off a shovel. Not more than twenty minutes shall be allowed from the time the concrete is mixed, until it is deposited, and tamped into place.

30. Forms.—All necessary forms shall be provided, set, and removed by the contractor for the concrete work.

All forms shall be of good, sound lumber, dressed so as to secure tight joints after the forms are wet down, preparatory to receiving the concrete. They must be true and rigid, and well braced so as to withstand all shock incident to construction.

All rubbish, etc., must be removed from the forms before placing the concrete. Forms must not be removed until the concrete is set sufficiently hard to permit this to be done with safety.

31. Depositing Concrete.—Concrete shall be conveyed from the mixer to the forms and placed so that there shall be no separation of the different ingredients. It shall be properly tamped, spading the stone back from the faces of the forms to give a mortar finish to the face, and puddling it well to work out all air bubbles.

Concrete for walls shall be poured in layers of not less than six inches, nor more than twelve inches at one time.

Not more than twenty minutes shall be allowed from the time the concrete is mixed until it is deposited and tamped into its position in the work. Whenever possible, each batch of concrete shall be placed before the previous concrete has set, so as to secure perfect bonding.

32. Footings and Foundation Walls.—The contractor shall put in footings under all walls, piers, columns, and chimneys, of the sizes and depths shown on the drawings, and shall build all foundation and area walls of the depths and thicknesses shown on the drawings. All are to be of concrete.

33. Concrete Floors.—Throughout the entire basement the contractor shall lay floors of concrete four inches thick. All floors, except in the laundry, basement stair hall, and closets, shall be finished with one-half inch of Portland-cement mortar mixed in the proportion of one part of cement and two parts of sand, floated on and troweled smooth. The finish shall be put on when the concrete is laid and is still wet.

The upper surface of the laundry floor, the basement stair hall, and closet floors, shall be kept three inches below the top of the other concrete floors.

Floor in boiler room shall pitch to the floor drain shown on plans.

34. Area Floors.—The contractor shall lay floors of concrete 4 inches thick in the area at the basement entrance, to be finished

with cement mortar as specified for floors. The area floor shall pitch to drain.

35. Foundations for Tile Floors.—The contractor shall lay concrete beds for all tile floors in side porch, breakfast porch, and in both bathrooms in the second story. The beds for porch floors shall be 4 inches thick, set on the earth fill and reinforced with No. 16 gauge unpainted, expanded metal 3-inch mesh, placed well within the mass of the concrete. Beds for bathroom floors shall be 3 inches thick, laid on wood platforms set by the carpenter contractor.

36. Concrete Steps.—The contractor shall build steps of concrete to the basement entrance where shown, as previously specified. Steps shall be finished as specified for floors.

37. Cast Concrete.—All cast concrete for steps to rear and side porches, copings around porches, thresholds to basement entrance, from side porch to living room, to front entrance, and to breakfast porch, and the caps on both chimneys shall be mixed in the proportions of one part of Portland cement, two parts of clean sharp sand, and two parts of broken stone or gravel which will pass over a ½-inch mesh and through a 1-inch mesh. It shall be mixed together dry and then moderately wet. Forms shall be oiled with raw linseed oil before casting. Concrete shall be thoroughly tamped into forms, and the forms shall be removed as soon as the concrete has hardened. All patching and surfacing of concrete shall be done with a one-to-one cement mortar applied with wooden paddles. After the concrete has set for twenty-four hours, cover it with wet sand and keep it wet for at least two weeks.

All thresholds shall be cast with seats and washes, and all work shall be reinforced, where necessary, with steel rods.

38. Cinder Fill.—On top of the concrete floor in laundry, basement stair hall, etc., lay cinder fill of the necessary thickness between the floor sleepers. Cinder concrete shall be composed of one part of Portland cement, two parts of clean sharp sand, and ten parts of clean steam cinders. Cinders must be thoroughly washed to remove all dirt and sulphides. Fill shall be deposited, thoroughly tamped, and leveled off true to receive the floors.

39. Kitchen Hearth.—The contractor shall lay concrete hearth in kitchen where shown. It shall be composed of one part of Portland cement, two parts of clean sharp sand, and three and one-half parts of stone screenings, grading up to ½ inch.

Hearth shall have a cement finish laid as an integral part of the hearth The contractor shall screed up the wet concrete with a straightedge, bringing it up level with the grade of the finished hearth.

While the concrete is still in a liquid state, it shall be floated down with a one-to-two mixture of Portland cement and sand, applied dry and worked into the top of the concrete. The surface shall be finished by giving it a hard fanning or burnishing, polishing it thoroughly, and eliminating all tool marks. Cover with wet sand within twenty-four hours, and wet down twenty-four hours afterwards.

REINFORCED CONCRETE

40. Reinforcing Steel.—The reinforcing steel shall be of an approved type of deformed bars, having a positive mechanical bond with the concrete. It shall be of medium- or structural-grade steel, and may be made either by the Bessemer or by the open-hearth process. Also see Item 35.

41. Reinforced-Concrete Slabs.—The concrete slab under the rear porch shall be a clay tile ribbed slab 4 inches thick, plus 1½ inches of concrete, reinforced with two ½-inch square rods in each rib. The slab under the vestibule shall be a 3-inch solid-concrete slab reinforced with ⅜-inch round rods 7 inches center to center in both directions. The slab under the front steps and platform shall be designed to receive the brick treads and risers, and the brick floor.

42. Floor Tile.—Floor tile shall be 12 inches by 12 inches and of the thickness shown. It shall be hard-burned, but not vitrified, and in no case shall it be soft or salmon-colored. The ends of all tile shall be cut square and true, so that when they are placed end to end, cement will not leak through the joints. Each face of tile shall have at least three scores, or corrugations, which shall be at least ⅛ inch deep and ⅜ inch wide. All walls and ribs of tiles shall be of standard thickness. No tile shall be used having holes broken out greater than six square inches on top or four square inches on the bottom. The open-end holes shall be plastered up before commencing to pour concrete.

43. Living-Room Hearth.—The living-room and side-porch hearths are to be formed of concrete to receive brick and tile hearths, the hearths to be cast on wooden forms and to be reinforced with rods or heavy expanded metal. The concrete hearths are to be brought to the proper level to receive the brick and tile finish of the hearths.

44. Work Built In.—Build in bolts for anchoring sills, clean-out doors, thimbles, coal chutes, pipe sleeves, floor drains, and any other ironwork required.

BRICKWORK

45. The contractor shall furnish and set all common- and face-brick work necessary for the completion of the building.

46. Common Brick.—All common brick must be of good quality, local hard-burned brick of even color, well-shaped and free from checked, swollen, or refuse brick. All brickwork below grade shall be laid in Portland-cement mortar. All brickwork above grade shall be laid in cement-lime mortar. All brick not laid in freezing weather shall be well wet before laying, and shall be carefully bedded and bonded with level, close, and completely flushed joints. Every sixth course shall be a header course.

All brickwork that is to be stuccoed shall have joints raked out to the depth of ⅝ inches.

Turn trimmer arch under kitchen hearth. This is to be set low enough to allow for the laying of the finished hearth.

47. Where Used.—The unexposed portions of all chimneys and the foundation for kitchen chimney breast shall be built of common brick.

48. Face Brick.—All face brick shall be selected red brick to cost not less than $35 per M., f. o. b. Scranton, Penn'a. They shall be laid in running bond, in cement-lime mortar, with tooled joints ½ inch thick.

All arch brick shall be properly ground to a radius.

49. Where Used.—The chimney breast on side porch and the facing of the living-room fireplace shall be laid up of face brick.

50. Mortars—All materials for mortars must be carefully measured in barrels or boxes, and mixed in plank mortar boxes. No mortar shall be mixed on the bare ground. The cement and sand must be carefully measured and first mixed together dry, water being added gradually.

All quicklime must be slaked in large, wooden boxes and allowed to stand not less than two weeks before using. Hydrated lime shall be soaked over night. Mortar that has once set must not be used on any of the work, and any work that may be built with retempered mortar, or with mortar composed of materials below the standards herein specified, must be taken down and rebuilt at the contractor's expense.

51. Portland-Cement Mortar.—Portland-cement mortar must be composed of one part of Portland cement and three parts of sand, dry measure, with the addition of ten per cent. by volume of hydrated lime or lime paste.

52. Cement-Lime Mortar.—Cement-lime mortar shall be composed of one part of lime paste, or hydrated lime, one part of Portland cement, and six parts of sand by volume.

53. Brick Steps and Floor.—The contractor shall lay up the brick steps and brick floor to the front-entrance stoop as shown on the detail drawings. Risers shall be a stretcher course, and treads shall be made up of headers on edge. Floor shall be laid running bond on edge. The brick shall be laid in cement mortar with slightly concaved joints.

54. Fireplaces.—The contractor shall build both fireplaces as shown on the drawings, to be constructed according to detail, and to be lined and have underfires of "Iron Clay" fire brick. They shall each be provided with Covert improved throat and damper, made by H. W. Covert Company, New York, N. Y., built in over the fireplace and acting as a lintel. Form windbreaks or shelves at the upper edges of the throats. Build Covert ash traps in fireplaces where shown.

55. Flue Linings.—Line all flues with terra-cotta flue linings of the sizes shown on the drawings, to have joints well bedded in mortar, and to be well flushed up to the brickwork. All flue linings shall be of the flue size marked on the drawings.

56. Stove-Pipe Collars—Build in terra-cotta stove-pipe collars of the proper size, in flues where required.

57. Register.—Build in where shown in kitchen chimney breast a register with movable slats.

58. Anchors.—The contractor shall furnish and set all anchors, wall ties, and other light ironwork required for his work.

59. Building In Work.—The mason shall build in, as the work progresses, any work furnished by all other trades employed on the building.

PLASTERING

60. Furring.—The contractor shall furnish and set all the necessary furring for hung ceilings, and, where required, to form beams and arches. Furr down ceilings of closets and small rooms as directed. Furr around all chimneys.

61. Wood Lathing.—The contractor shall lath all stud partitions and ceilings in the basement, first, second, and third stories, except where metal lath is specified, including the ceilings of the rear porch, breakfast porch, and service porch and the stair soffits. The lath

are to be green spruce or white-pine lath, free from bark or dead knots, and of full thickness. Lath are to be spaced not more than ⅜ inch apart, with four nails to each lath; joints must be broken every seventh lath, and the ends must be ¼ inch apart. No lath shall be put on vertically and no lath shall be run through angles nor behind studding from one room to another.

62. Metal Lathing.—The contractor shall lath the ceiling of the boiler room in the basement, behind the tile wainscot in both bathrooms in the second story, and over all steam risers that are concealed in stud partitions, with an approved pattern painted expanded-metal lath to weigh not less than 2.5 pounds per square yard. Lath shall be well stapled to studs with 1¼-inch No. 14 gauge galvanized staples placed not less than 8 inches apart. Lath shall be given a lap of at least 3 inches, and shall be well wired together, and be folded around all corners at least 3 inches.

63. Cement Plaster.—The metal lath behind the tile wainscots shall be plastered with a ½-inch coat of Portland-cement mortar, floated on and scratched horizontally to form a backing for the tile. Mortar shall be composed of one part of Portland cement, and three parts of clean, sharp sand.

64. Plastering Materials.—All plaster used in the work shall be the best quality of any of the following brands: "Diamond", "Empire", "Niagara", or "Peerless". It shall be applied under instructions furnished by the manufacturers. Finishing coat shall be either "Tiger Brand White Rock Finish", or "Ivory Hydrate", properly gauged with calcined plaster.

65. Plastering.—All plastering on brickwork shall be done in brown and finishing coats, and on lath it shall be done in scratch, brown, and finishing coats, except in the basement, where it shall be done in scratch and brown coats. The contractor shall screed over for the brown coat to obtain perfectly true work, then float on the brown coat, straightening it with rod and darby, and bringing it to an even surface. The finishing coat shall be thoroughly troweled on and left perfectly smooth, hard, and free from brush marks.

All surfaces intended to be plastered must be thoroughly cleaned off and well wet down before any plastering is done. All wood lath must be drenched with water applied with a hose before plastering. Each coat of plaster must be thoroughly dry before the succeeding coat is applied.

Plastering must go to the floor level wherever possible, and shall finish up to and flush with all grounds.

All external angles shall be protected by approved metal corner beads.

66. Work to Be Done.—All walls and ceilings in the first floor, including those in breakfast porch; all walls and ceilings in the second floor; all walls and ceilings in the finished parts of the third floor; the soffits of all staircases where exposed; the ceiling over entire basement; both sides of stud partitions around drying room, laundry, stair hall, toilet, and closets in basement, shall be plastered as above specified.

67. Ornamental Plaster.—The contractor shall run cornices in first-story hall, living room, and dining room, according to full-size detail.

68. Patching.—After all trades on the building, including the plumbing, heating, and electric trades, have completed their work, the plasterer must patch and make good all broken and defective plaster in the best and most workmanlike manner, and to the satisfaction of the architects, leaving all plaster free from cracks, stains, and other defects.

69. Freezing Weather.—No plastering shall be done in freezing weather unless the building is heated. The carpenter will close up all openings communicating with the outside air, as hereinafter specified. If temporary heat is required, it will be furnished by the owner.

70. Rubbish.—The plasterer must clean up each floor promptly after each coat of plaster is applied, and remove all rubbish from the premises.

CEMENT STUCCO

71. Sheathing Paper.—The walls where stuccoed are to be covered with a layer of waterproof building paper weighing 10 pounds to the square, and lapped 2 inches. Paper is to be furnished and applied by the contractor for the stucco work.

72. Lathing.—The contractor shall set $\frac{7}{8}\times 1\frac{1}{2}$" wood furring strips on the sheathing over the center of each stud on all outside walls, also on interior walls of rear porch and sleeping porch. Over these furring strips place approved pattern galvanized expanded-metal lath weighing not less than 3.4 pounds per square yard. Lath shall be stapled to furring by means of $1\frac{1}{2}$-inch No. 14 gauge galvanized staples, spaced not over 8 inches on centers. Staples must span the heavy ribs of the lath. Lath must be given a lap of at least 2 inches on the ends and edges, and be wired with No. 18 gauge annealed tie wire. Ties shall be spaced not over 6 inches on centers. All lath must be put on horizontally.

73. Stucco.—The contractor shall plaster all exterior walls, the interior walls of all porches except breakfast porch, and all chimneys

where indicated on the drawings with cement mortar; also ceilings of rear and service porches. Mortar shall be composed of one part of Portland cement, three parts of clean, sharp sand, and one-tenth part of hydrated lime.

Mortar for the first coat on lath shall have a small quantity of long cattle hair or goat's hair added. Stucco shall be applied in three coats, each coat to be not less than $\frac{1}{4}$ inch in thickness, and not over $\frac{3}{8}$ inch in thickness. The first coat shall be applied under pressure to secure a good key. After the first coat has set, but before it has dried, the second coat shall be applied and floated to a true plane. The plastering shall be carried continuously in one general direction without allowing the mortar to dry at the edge. Where this is impossible, the joints shall be made at the openings or at the other natural divisions.

The undercoat shall be cross-scratched before the intial set has taken place, and each coat shall be thoroughly wetted before the succeeding coat is applied. The finishing coat, after being brought to a smooth, even surface, shall be rubbed with a wood float using a circular motion, a little sand being added to roughen the surface slightly. This floating shall be done when the mortar has slightly hardened. The water-table course shall be run from the same mortar that is used for the stucco.

MARBLE AND TILE WORK

74. Marble Saddles.—Saddles between vestibule and hall, and between dining room and breakfast porch are to be of approved white marble worked to detail. They are to be secured to wood supports by means of brass screws.

75. Tile Work.—The contractor shall lay the following tile floors, base, wainscot, and hearth:

Vestibule, side porch, rear porch, and breakfast porch shall have floors of 9″×9″ smooth, red quarry tiles.

The two owner's bathrooms in the second story shall have floors of $1\frac{1}{16}$″×$\frac{1}{2}$″ oblong virteous tile laid herringbone pattern, and wainscot 5 feet high of 3″×5″ gloss-finished enameled tile, with 6-inch sanitary cove base, molded cap, and plinth blocks.

The fireplace in the living room shall have a hearth of 6″×6″ glazed semivitreous tile, color to be selected by the architects.

Floor tile shall be selected and wall tile, base, etc., shall be standard. All tile shall be properly set. Floor tile shall be laid on the concrete beds hereinbefore specified. They shall be laid on one inch of cement mortar. Both bathroom floors shall have a galvanized-wire mesh of approved type and size bedded in the setting mortar.

Quarry tile shall have joints ½ inch wide slightly concaved. All joints in floor tile shall be grouted with non-staining Portland-cement mortar mixed with clean water. All wall tile shall be buttered, and shall have the joints cleaned out and pointed up with non-staining Portland-cement mortar. All tile work shall be thoroughly cleaned at the completion of the work.

76. Accessories.—The contractor shall furnish and build in one "Fairfacts" white glass shelf 30″×5″×$\frac{7}{16}$″ with china brackets No. F322, and one non-slip towel bar 36 inches long, with china posts No. F303. These accessories are to be placed in the bathroom off bedroom No. 3.

MISCELLANEOUS IRONWORK

77. The work under this contract shall include: Columns, coal chutes, clean-out doors, pipe railings, area gratings, vent registers, and thimbles.

78. Columns.—All columns in basement shall be standard black mild-steel gas pipe of the sizes shown, and shall have cast-iron caps and bases.

79. Coal Chutes.—The contractor shall furnish and set, where shown on the drawings, two No. 10 style B Majestic coal chutes.

80. Clean-Out Doors and Frames.—The contractor shall furnish and build in the following heavy cast-iron clean-out doors and frames of approved pattern; one in ash pit, 16″×16″; one in boiler flue 12″×12″; and one in laundry flue, 8″×12″. The frames shall be provided with two wrought-iron anchors, one on either side, for securing them to the brick and concrete work.

81. Pipe Railings.—The contractor shall furnish and set where shown on steps to rear porch and basement-entrance area, 1½-inch inside-diameter black wrought-iron pipe railings, put together with Crane Company's ball-pattern malleable-iron railing fittings. Railings shall be properly secured to concrete by means of expansion bolts.

82. Area Gratings.—The contractor shall furnish and set a wrought-iron grating over the area on the east side of the building. It shall have frame made up of 1¾″×⅜″ bars and cross-bars 1¼″×⅜″, spaced 1½ inches on centers. Cross-bars shall be tenoned into frame and well riveted. Frame shall be set 2 inches into area coping. Grating shall have a row of cast-iron thimbles strung on a ⅜-inch rod in the center of the span.

83. Vent Register.—The contractor shall furnish for kitchen vent flue one cast-iron plain lattice vent register finished in white enamel.

84. Painting.—All iron and steel work shall be thoroughly cleaned of all mill scale, dirt, rust, and oil in the shops, and given one good coat of pure red lead and linseed oil. All exposed steelwork and ironwork shall be painted, as hereinafter specified.

CARPENTER WORK

85. Timber.—All timber for posts, girders, floor joists, and rafters shall be No. 1 spruce or white pine; all timber for sills, plates, studding, etc., shall be No. 2 white pine and dimension. It shall be sized to dimensions one side and edge. Timber shall be free from any defects that may impair its strength or durability. The contractor must furnish and set any timber of the proper size and kind necessary to the completion of the building, whether specifically mentioned or not.

NOTE.—The kinds of wood used for different purposes in different parts of the country vary. The wood commonly used in any locality may be substituted for any of the woods mentioned in this specification.

86. Sizes.—The general sizes of timber shall be as follows:

Sills, 4″×6″
Studding, 2″×4″—16″ on centers; corner posts, 3–2″×4″
Wall plates, 2″×4″ doubled
Floor joists, 2″×10″—16″ in centers
Ceiling joists (third story), 2″×6″—16″ on centers
Rafters, 2″×6″—24″ on centers
Bridging, 1″×3″—not over 7′ 0″ on centers
Sheathing, 1″×6″ No. 2 common boards, hemlock.

NOTE.—The framing specified is balloon framing. If another type of frame is used, the specifications may be modified accordingly.

87. Cutting.—The contractor shall do all the cutting and fitting of woodwork to accommodate the work of all other contractors employed on the building, including the plumbing, heating, and electric contractors, and he must make good after them, finishing the work in a manner satisfactory to the architects.

88. Work for Other Trades.—The contractor shall furnish and set all rough and finished woodwork necessary for all trades, such as pipe boards for the plumber, meter boards, brackets, cleats for plumbing fixtures. All finished woodwork for fixtures must match the finish of the work they support. Forms for concrete are not included in this work.

89. Enclosing Building.—If the work is done during cold weather, the contractor must close up all openings connecting with the outside air until the glazed sash are put in place. It shall be done with strong frames properly braced and covered with heavy muslin. This

contractor is not to include the cost of this item in his total bid, but is to submit a separate price for which he will do the work if required.

90. Framing.—All work shall be framed in the most thorough and workmanlike manner. All sills shall be halved and lapped at the corners. Trim around all openings and chimneys. In no case shall headers or trimmers be less than two inches from the chimney. All headers and trimmers must be doubled or tripled, and all headers over 4′ 0″ long must be hung in heavy wrought-iron stirrups or Duplex hangers, and all tail beams must rest on cleats nailed to the side of the header.

The contractor shall set all partitions according to plans, and they shall be bridged with one row of herringbone bridging. Double all studs around openings, and double all headpieces over openings and truss over openings.

91. Boxing Around Soil Pipes.—Where soil pipes run in first-story walls, the contractor shall box around pipes with ⅞-inch boards, making the same tight at the bottom, and pack around pipes with dry sawdust.

92. Grounds.—The contractor shall furnish and set ¾″×1½″ beveled white-pine grounds for all door and window openings in plastered walls throughout the building; also, all necessary dressed white-pine grounds for all wainscot, paneling, base, etc.

93. Floor Sleepers.—On top of the concrete floor in laundry, basement-stair hall, and the adjoining closets, the contractor shall furnish and set 2″×4″ sleepers of spruce or white pine, beveled on on both sides, to be spaced 16 inches on centers and securely nailed to "Peds" manufactured by the General Fireproofing Company. Cross-brace sleepers with the same material as the sleepers.

94. Underflooring.—Throughout the entire building, including service porch, except in basement and where tile floors are called for, lay underflooring of No. 2 common boards matched and surfaced, either white pine, North Carolina pine, or spruce, laid diagonally and securely nailed to each joist.

95. Roof Sheathing.—All roofs shall be sheathed with standard sheathing boards of even thickness, (or, 1″×4″ shingle lath shall be applied over the pitch roofs, placed 5½ inches on centers.) The flat-deck roofs shall be sheathed with standard sheathing.

96. Platforms for Concrete and Insulation.—Under all tile floors in the second story and under the floor over the service porch, the contractor shall set platforms of ⅞ inch boards cut in between the

joists and resting on cleats nailed to the joists. Platforms to be set down low enough to allow for 3 inches of concrete and the tile flooring, and for 3 inches of insulation where called for. Bevel the tops of joists where tile floors occur.

97. Insulation.—The contractor shall fill on top of platforms between the floor joists in floor over service porch with mineral wool, packing it tight and filling all crevices.

98. Porch Floor.—The floor of service porch shall be $1\frac{1}{8}$-inch tongued-and-grooved B edge-grain yellow-pine flooring, to be in single lengths. Flooring is to be laid with a pitch away from the walls. It shall be blind-nailed to every bearing and shall finish against the walls with a $\frac{3}{4}$-inch quarter round.

99. Shingles.—The contractor shall cover the slopes of roof, the roofs and cheeks of dormers, with 16-inch Extra Clear red-cedar or Bests cypress shingles, laid $4\frac{1}{2}$ inches to the weather on roofs, and $5\frac{1}{2}$ inches to the weather on cheeks of dormers.

Each shingle shall be nailed with two 3d. galvanized common nails. All joints must be broken at least $1\frac{1}{2}$ inches, and care must be taken that no break comes directly over another. Where shingles come against window casings, nail only on the side next to the casing. Shingles on external angles of dormers shall be lapped over each other alternately. Hips and ridges shall be Boston hips and ridges.

EXTERIOR FINISH

100. Materials.—All exterior finish of every sort unless specified otherwise shall be of white-pine C select finishing, and made in accordance with the drawings and details.

101. Exterior Cornice.—The contractor shall build the exterior cornice according to details. The cornice is to be constructed in a thorough and workmanlike manner. The cornice shall have false rafters $2\frac{1}{2}$ inches thick, cut to pattern and spiked to main rafters. The under side of the overhang shall be sheathed with $\frac{13}{16}$-inch tongued-and-grooved ceiling.

102. Porches.—All porches shall be constructed according to details, with molded cornices, turned columns, balustrades, etc. Cornices shall have box gutters formed as shown on the drawings. The columns on the side porch shall be Koll's Patent Lock Joint Staved columns, with 2-inch staves, to have molded caps and bases. All square columns and pilasters shall have lock-mitered corners glued with waterproof glue.

Balustrades shall be made up with square posts with molded caps, molded toprails, and $\frac{1}{8}$″×$1\frac{3}{8}$″ filling bars halved together. Steps to service porch shall have $\frac{7}{8}$-inch risers and $1\frac{1}{8}$ inch yellow-pine treads, 4″×4″ newels, molded rails, and $1\frac{1}{8}$″×$1\frac{1}{8}$″ plain balusters, set three to a thread, balusters in railing and around porch to be the same as on the steps.

The jib under steps shall be filled with lattice made up of $\frac{3}{16}$″×$\frac{3}{4}$″ strips. Lattice in sides of service porch shall be made up of $\frac{1}{8}$″×$1\frac{3}{8}$″ strips halved together.

Ceiling of the side porch shall be formed of $\frac{7}{8}$-inch V-joint B grade yellow-pine ceiling.

103. Flower Boxes.—The flower boxes under the windows of the breakfast porch shall be built up according to details of $1\frac{3}{8}$-inch stock, and shall be lined with No. 9 sheet zinc, joints in lining to be well sweated and soldered.

104. Window Frames.—All window frames throughout the building shall be constructed according to details. All double-hung sash shall have frames with $1\frac{1}{8}$-inch molded outside casings, $1\frac{1}{8}$-inch B grade yellow-pine pulley stiles and yokes, $\frac{1}{2}$-inch yellow-pine parting beads, $\frac{1}{2}$-inch stop beads, 2-inch double-rabbeted sills.

Casement windows and sliding windows on porch shall have $1\frac{3}{4}$-inch rabbeted frames with 2-inch rabbeted sills and $1\frac{1}{8}$-inch outside casings, all to be according to details.

Basement window frames shall be $1\frac{3}{4}$ inches thick, rabbeted with $1\frac{3}{4}$-inch sills and $1\frac{1}{8}$″×$1\frac{3}{8}$″ staff beads; frames shall have 2″×2″ wind stops nailed to backs of jambs. The double-hung window in the drying room is to have a box frame.

105. Sash.—All sash, except where specified otherwise, shall be $1\frac{3}{4}$ inches thick, of white-pine, factory A select lumber, according to details. They shall be mortised, tenoned, and pinned together, all joints to be set in white lead. All double-hung sash shall be hung with Samson Spot Cord, over noiseless sash pulleys with $2\frac{1}{4}$-inch turned wheels and roller-bearing axles, and with cast-iron weights.

Casement sash shall have rabbeted meeting stiles and drip molds. All glazing of casement sash shall be done by means of wood strips bedded in putty. Sliding sash in sleeping porch shall have Corbin shutter sheaves No. $753\frac{1}{4}$ and track No. $990\frac{1}{4}$. Basement sash shall be $1\frac{3}{8}$ inches thick. Sidelights and transoms over doors shall be $1\frac{3}{4}$ inches thick of same detail as window sash.

106. Shutters and Blinds.—The contractor shall furnish and hang at all windows in the first story where shown, paneled shutters $1\frac{1}{8}$ inches thick, made according to detail, upper panels cut out as shown, and at all windows in second story, where shown, $1\frac{1}{8}$ stock blinds with movable slats.

107. Door Frames.—Front-entrance door frame and breakfast-porch door frame shall be made 1¾ inches thick, rabbeted with mullions and transom bars and molded sills and panel backs under sidelights and according to details.

All other entrance-door frames shall be 1¾ inches thick rabbeted. All entrance doors having concrete thresholds, except basement entrance, shall have molded white-oak saddles, 1⅛ inches thick. Service-entrance door and door to rear porch shall have 2-inch rabbeted white-oak sills.

Basement-entrance door frames shall have 2″×4″ wind stops nailed to backs of jambs. Frames shall be held in place by means of wrought-iron joggles screwed to jambs, two to each side.

All interior-door frames shall be 1⅛ inches thick with ⅝-inch adjustable stops plowed in. Frames shall be blocked up for hardware and securely wedged to studding.

Sliding doors shall have 1⅜-inch jambs and heads, pockets to be lined with ⅞-inch matched ceiling. Doors shall be hung on Richards-Wilcox Twin Trolley ball-bearing house-door hangers.

108. Doors.—All doors shall be of white-pine, factory A select lumber, except the doors to coal bins, vegetable cellar, and dark cellar. Doors shall be built according to details, with solid stiles, rails, panels, and mortise-and-tenon joints. Tenons shall be blind tenons properly wedged and glued. Rails shall be glued and pine cleats of the proper thickness glued into them to receive the moldings, so that the panels may be loose. Doors shall be paneled and molded, as shown, and shall be glazed or have glazed upper panels, where shown.

French doors from living room to side porch, and entrance doors to breakfast porch shall have astragals. Sliding doors to dining room shall have beveled tongued-and-grooved astragals and ¼-inch chafing strips.

Mirrors in doors in bedrooms Nos. 2 and 3 shall have proper felt backing, and be provided with molded stop beads.

All glazing of glazed doors shall be done by means of wood stops, bedded in putty.

All exterior doors shall be 2¼ inches thick, and all interior doors shall be 1¾ inches thick. Doors to coal bins, vegetable cellar, and dark closet shall be battened doors built up of ⅜-inch common matched boards with ⅜-inch battens and braces.

INTERIOR FINISH

109. Materials.—All interior finish throughout the first and second floors, except in kitchen, kitchen closet, and servants' bedroom and bathroom, shall be B select and better finishing white pine; finish in basement, kitchen, kitchen closet, servants' bedroom and bathroom in second story, and throughout the third story shall be D select white pine.

All finish shall be according to scale and full-size details, put up with closely-mitered joints, well smoothed and sandpapered with the grain. Exposed end grain will not be allowed on any of the work.

110. Sheathing of Partitions in Basement.—The contractor shall sheath up all partitions around coal bins and vegetable cellar with No. 2 common boards.

111. Door and Window Trim.—All doors and windows in first and second stories, except in kitchen, kitchen closet, servants' bedroom and bathroom, shall have molded trim $\frac{13}{16}$"×6½", according to detail. All doors and windows in finished portions of basement, kitchen, kitchen closet, servants' bedroom and bathroom, all closets, and throughout the third floor shall have plain trim $\frac{13}{16}$"×5". All door trim shall have plinth blocks 1⅛ inches thick by the height of the base. Windows shall have 1⅛-inch molded stools and $\frac{13}{16}$-inch molded aprons.

112. Base.—The contractor shall install base in the various rooms, as follows: vestibule, hall, and breakfast porch, $\frac{13}{16}$"×6" plain base; dining room, kitchen, pantry, and all bedrooms in second story, $\frac{13}{16}$"×6" base, with 1¼-inch cap mold; all rooms in finished portion of basement, all closets, and all rooms throughout the third story, $\frac{13}{16}$"×5" plain base; all to be made according to detail.

113. Paneling.—The contractor shall form panels on the walls of vestibule, breakfast porch, and west wall of dining room, by applying $\frac{9}{16}$-inch wood stiles and rails to the surface of the plaster. Panels shall be arranged as shown on the drawings.

114. Wainscot.—The contractor shall install paneled wainscot 4' 6" high with molded base and cap, according to detail in living room.

115. Chair Rail.—The contractor shall install molded chair rail $\frac{13}{16}$"×3" in the dining room. Height of chair rail shall be as shown on the drawings.

116. Picture Mold.—The contractor shall install $\frac{13}{16}$"×1½" picture mold in living room, dining room, and all bedrooms in the second story.

117. Cornices.—The contractor shall install wood cornice according to details in vestibule and breakfast porch.

118. Mantels.—The contractor shall furnish and install the mantel in living room, to cost not more than $75; also the wood shelf and brackets for brick mantel on the side porch; all to be made according to details.

119. Bookcases in Living Room.—The contractor shall install the bookcases in living room where shown on the drawings. They shall be built according to details. Shelves shall be 1⅛ inches thick and molded, set on Corbin shelf pins.

120. Columns Between Hall and Living Room.—The contractor shall install the columns, pilasters, etc., between hall and living room, to be made up according to details. Columns shall be Koll's Patent Lock Joint Staved columns, with molded bases and caps. Pilasters shall be made up with lock-mitered corners, and have molded bases and caps. False beams over columns shall be molded as shown, and have paneled soffit.

121. Pilasters in Dining Room.—The pilasters on west wall of dining room shall be made according to details, with molded caps as shown.

122. Dressers.—The contractor shall install dressers where shown in pantry and kitchen, to be built according to details. They shall have counter shelves, 1⅛ inches thick, 2′ 8″ above the floor, with drawers and cupboards as shown. Lower cupboard shall have paneled doors 1⅛ inches thick. Upper cupboards shall have glazed doors 1⅛ inches thick and three ⅞-inch movable shelves set on Corbin shelf pins. Dressers shall be lined with $\frac{5}{16}$-inch V-joint dressed-and-matched ceiling, and shall have panel-backs behind the counter shelves, as shown.

123. Seat in Living Room.—The contractor shall install the seat where shown in living room. Front shall be 1⅛ inches thick, with open panels to receive grilles set by heating contractor; the top shall be 1⅜ inches thick. Interior of seat shall be lined with sheet asbestos ⅛ inch thick.

124. Closets.—The contractor shall install ⅞-inch shelves set on beaded hook strips in all closets in finished portion of the basement, the coat closet in first story, and all closets in all bedrooms and bathrooms in the second and third stories.

125. Broom Closet.—The contractor shall install broom closet in first-story rear hall. It shall have 1⅛-inch paneled doors and ⅞-inch hanging strip, and one shelf.

126. Linen Closet.—The contractor shall install linen closet where shown in second-story rear hall. It shall have paneled doors 1⅜ inches thick, to match doors in hall, and ⅞-inch shelves spaced 9 inches apart, set on beaded cleats. Closet shall be lined with ⅝-inch V-joint dressed-and-matched ceiling.

127. Shelving in Store Closet.—The contractor shall install six ⅞-inch shelves in store closet off kitchen. They shall be set on beaded cleats.

128. Shelving in Basement.—The contractor shall install the shelving shown in basement. Dark closet shall have six ⅞-inch shelves set on beaded cleats, and the preserve closet in vegetable cellar shall have three ⅞-inch shelves, and 1⅛-inch doors filled in with ½-inch galvanized mesh.

129. Cedar Room.—The contractor shall line the walls and ceilings of cedar room in third story with ⅝-inch tongued-and-grooved red-cedar ceiling, with quarter rounds at angles of floor and ceiling.

130. Staircases.—The contractor shall build all staircases where shown on the plans, to be according to scale and full size details. They shall be supported on heavy plank stringers. Treads shall be 1⅛ inches thick, and risers shall be ⅞ inch thick, to be tongued and grooved together, risers into treads and treads into risers. The treads, risers, and stringers in main staircase shall be wedged and glued together and properly housed.

Steps shall have molded nosings. Treads in main stairs from first to second story shall be of firsts and seconds straight-sawn white oak, and the treads in all other stairs shall be B grade of yellow pine. The balance of woodwork shall be B select and better finishing white pine, except the hand rails of stairs, which shall be firsts and seconds birch.

Main staircase shall have 2½″×3″ molded rail, as shown. Rail shall start in the bottom with a spiral which shall cap the newel, and shall have easements where shown. Starting newel shall be 2¼ inches in diameter, turned as shown. Balusters shall be plain-turned, tapering from 1⅛″ to ⅞″, spaced three to a tread, and dovetailed into treads. Balusters on landings shall be spaced the same as those on steps.

Rear stairs to basement and stairs to attic shall have plain round rails 2¼ inches in diameter supported on malleable-iron brackets. All finished stair work shall be properly put together at the shop and delivered at the job ready to set. Before laying out his work, the stairbuilder must take all measurements of rough strings, etc., at the building. Hand rail shall be worked out at the shop, and shall be put together by means of hand-rail bolts.

131. Deafening.—The contractor shall deafen the wood floors in the first and second stories with Cabot's Quilt single-ply laid on top of the underflooring.

132. Finished Floors.—The contractor shall lay finished floors of $\frac{13}{16}$"×2¼" face, tongued-and-grooved, end-matched, select plain-sawn white oak, in the hall in first and second stories, living room, dining room, and toilet. Floors in pantry, kitchen, all bedrooms in second story, except servants' bedroom, shall be $\frac{13}{16}$"×3¼" tongued-and-grooved B edge-grain yellow pine. Floors in basement, closets, servants' bedroom and bathroom in second story, and throughout the third story shall be $\frac{13}{16}$"×3¼" tongued-and-grooved C edge-grain yellow pine.

In laying finished flooring it shall be driven up tight and blind-nailed to every joist; joints shall be well broken and flooring carried up close to base. Flooring shall not be laid until the plastering is thoroughly dry and standing trim is in place Floors shall be planed and scraped smooth after laying, and protected until the painter is ready to apply the finish.

133. Saddles.—The contractor shall set molded B grade yellow-pine saddles to all doors to closets and bathrooms in second story, and firsts and seconds straight-sawn white-oak saddles to doors to coat closet and toilet in first story. Saddles shall be $\frac{13}{16}$ inch thick by the thickness of the partitions.

HARDWARE

134. The contractor for carpentry shall furnish and set all rough and finished hardware necessary for the completion of the building, whether specifically mentioned or not, of suitable sizes, with all necessary fastenings and attachments. All finishing hardware shall be of the best quality of either Yale & Towne, P. & F. Corbin, or Sargent & Company's make. It shall be of cast bronze, wrought bronze, and wrought steel, to be light statuary finish, except in toilet and bathrooms, which shall be nickel-plated. The contractor shall allow the sum of $475 for the finishing hardware.

SHEET-METAL WORK AND ROOFING

135. Flashing.—The contractor shall do all necessary flashing, whether specifically mentioned or not, using 14-ounce soft copper, roofing temper (M-F brand IC tin, 32 pound coating on Keystone copper steel). All flashing shall be carried up eight inches on vertical surfaces and shall be cap-flashed.

NOTE.—An alternate material is specified in parentheses. Either one of these materials may be specified.

Cap-flashing must extend three inches over the flashing and be built into the masonry four inches. Where this is not possible, they must be let into reglets cut into the masonry and the joint filled with the best quality elastic roofing cement.

(If tin flashing is specified.) All flashing shall be painted one coat on the under side before laying, and shall be given two coats of paint on all exposed surfaces. The valleys shall be lined with the above tin and painted, as above specified.

136. Gutters and Leaders.—The contractor shall furnish and set at the eaves of main roof a 4″×6″ gutter of 14-ounce hard cornice-temper copper, hung in brass hangers (No. 26 gauge galvanized Armco iron, hung in galvanized iron hangers) to be properly braced and stayed. Leaders shall be 3″×4″ and 1¾″×2¾″ of 14-ounce hard copper (No. 26 gauge galvanized Armco iron) to have ornamental box heads and copper (galvanized-iron) goosenecks, and be held in place by means of copper (galvanized-iron) straps. They are to be located where shown on the drawings.

Leaders shall be protected at the top by means of copper (galvanized iron) wire baskets, and finish at the bottom with cast-iron shoes with spigot ends to connect with the drainage lines.

137. Metal Roofs.—(If tin is specified.) On the roofs of vestibule, side porch, breakfast porch, sleeping porch, and the flat deck on main roof, including the parapet around roof of sleeping porch, the contractor shall lay flat-seam roofs of M. F. brand IC tin, 32-pound coating on Keystone copper steel. Roofing shall be applied the narrow way of the sheet, using 14″×20″ sheets, staggered joints. Each sheet shall be secured to the roof sheathing by means of 1½″×3″ tin cleats locked into the seams, using two cleats to each side of sheet. Cleats shall be nailed to roof sheathing with two 1-inch barbed nails. No nails shall be driven through the sheets. Thoroughly sweat all seams with solder, using solder composed of one-half pig lead and one-half block tin, new metals. Use rosin only as a flux.

Line gutters and sump with the tin just specified. All cross-seams shall be thoroughly sweated with solder, and all laps made in the direction of the drainage.

(If copper is used.) On the roofs of vestibule, side porch, breakfast porch, sleeping porch, and the flat deck of main roof, including the parapet around the roof of the sleeping porch, the contractor shall lay flat-seam roofs of 14-ounce soft roofing temper copper. Roofing shall be applied the narrow way of the sheets, using 14″×20″ sheets, staggered joints. All copper sheets shall be tinned at least 1½ inch wide all around on both sides, and shall be properly notched. Each sheet shall be secured to the roof sheathing by means of 1½″×3″ copper cleats, locked into the seams, using two cleats to each side of sheet. Cleats shall be nailed to roof sheathing with copper nails. Thoroughly sweat all seams with solder composed of one-half pig lead and one-half block tin, new metals. Use chloride of zinc (cut acid) only as a flux. Line gutters and sump with the copper just specified. All cross-seams shall be thoroughly sweated with solder and all laps made in the direction of the drainage.

138. Painting.—(If tin is used.) The roofer shall paint all tin work, which includes the flashings and roofs, using red lead, iron oxide, metallic brown, or Venetian red paint, mixed with pure linseed oil. No turpentine or patent driers shall be used. All paint shall be applied with hand brushes and well rubbed on. All tin shall be painted on the under side before laying, and all exposed surfaces shall be painted immediately after laying, and a second coat shall be applied two weeks later.

139. Waterproofing Under Porch Floor.—The contractor shall lay one thickness of saturated roofing felt over the underflooring of service porch, lapping the joints 3 inches, and nailing securely with large-headed galvanized nails. Before laying the upper floor, mop this felt with hot coal-tar pitch.

PAINTING

140. General.—The contractor shall do all painting necessary to properly complete the building.

141. Shellacking and Priming.—The contractor shall cover all knots, sap, or pitchy places with strong sheliac, before applying the priming coat.

The painter shall prime all woodwork which is to be painted. The priming shall consist of pure white lead (Carter or equal) and pure cold-pressed linseed oil.

142. Puttying.—After the priming has dried and before the second coat of paint is applied, all work is to be cleaned, all cracks and nailholes are to be puttied up, and any imperfections or damaged work repaired.

143. Exterior Painting.—All exterior woodwork shall be painted three coats, including the priming coat, of pure white lead (Carter or equal) and pure cold-pressed linseed oil, with the addition of 15 per cent. of French zinc white and tinting colors. Tints to be selected by the architect.

All exposed iron and steel work shall be painted three coats of the above specified lead-and-oil paint in addition to the priming coat given it in the shop. All galvanized sheet-metal work shall be cleaned with vinegar or acetic acid and given one coat of red lead mixed with one-third of boiled linseed oil and two-thirds of raw linseed oil, and two coats of white lead and oil, as already specified. Floor of service porch and treads of steps to porch shall be given two coats of boiled linseed oil.

144. Interior Painting.—All woodwork in vestibule, living room, dining room, hall, first and second stories, except hand rail and treads of all stairs, and the three bedrooms in the second story shall be given one coat of white lead broken in equal parts of pure linseed oil and pure spirits of turpentine with a small quantity of Japan drier added. When dry, sandpaper with OO sandpaper; give two coats of Vitralite undercoater, tinting the second coat where directed; then give two coats of eggshell Vitralite. Tints to be as directed by the architect.

Sandpaper the under coats and allow forty-eight hours for drying between coats. All woodwork in toilet, kitchen, pantry and both bathrooms in second story shall be given one coat of white lead, and two coats of Vitralite undercoater, as above specified, and two coats of gloss Vitralite. Sandpaper each coat and allow forty-eight hours for drying between coats; final coat shall be left in the gloss.

All woodwork in the finished portions of basement, all closets, rear stair halls, except stair rails, servants' bedroom and bathroom, and throughout the third story, shall be given three coats of white lead and oil, as specified for exterior woodwork.

The hand rails of stairs shall be given one coat of approved acid stain, one coat of either Wm. Zinnser and Company's or Berry Brothers' white alcohol shellac, and two coats of either Pratt & Lambert's No. 38 Preservative Varnish or Berry Brothers' Luxberry wood finish. Sandpaper lightly between coats and rub the final coat with pulverized pumice stone and oil.

The walls and ceilings of toilet, kitchen, pantry, and two bathrooms shall be given two coats of Hockaday's Interio. The first coat shall be composed of one part body and one part thinner; the second coat shall be applied straight. All air cracks, water spots, and suction must be overcome in the second coat. Interio must be flowed on without brushing out, and no oils or thinners shall be used except those furnished by the manufacturers.

The ceilings in hall, living room and dining room shall be given one coat of Sherwin-Williams Decotint, mixed to the consistency of cream and applied with a wide kalsomine brush. Colors to be selected by the architect.

All oak floors and stair treads shall be filled with an approved paste filler, colored as directed. Rub off surplus filler with burlap or excelsior, rubbing across the grain of the wood. Give two coats of either Wm. Zinnser's or Berry Brothers' pure white shellac, then give two coats of Berry Brothers' floor wax, well rubbed with a weighted floor brush, and polished with a soft cloth.

All yellow-pine floors and stair treads, except in basement, kitchen, store closet, and pantry, shall be given one coat of approved oil stain, and two coats of Pratt & Lambert's No. 61 Floor Varnish. Floors in kitchen, pantry, and store closet shall be given a coat of Berry Brothers' Lionoil.

All floors shall be thoroughly cleaned before finishing, removing all grease and stains with a weak solution of ammonia and water.

GLAZING

145. The contractor shall glaze all windows, glazed doors, etc., unless otherwise specified, with D. S. A. A. (double-strength first quality) glass. All glass shall be bedded, puttied, and back-puttied, using putty composed of pure linseed oil and whiting. All casements and glazed doors shall have the glass held in place by means of wood stops bedded in putty.

146. Mirrors.—Two plate-glass mirrors, ¼-inch thick, are to be supplied and fitted to one door in bedrooms Nos. 2 and 3. The contractor shall be responsible for all breakage of glass, and must make good all glass before the completion of the building, clean all paint and other spots from the glass, and leave it clean and whole. All glass must be labeled.

PLUMBING

147. The work under this contract is to cover the complete installation of the plumbing, which is to include all fixtures, supplies, wastes, etc., as shown on the plans or called for in these specifications, including a complete hot-water system and supply to fixtures. All work shall be done in a neat and workmanlike manner, and according to the ordinances and rules of the City of Scranton.

148. Materials.—All materials shall be of the best of their several kinds, and of a manufacture approved by the architect.

149. Cast-Iron Pipe.—All cast-iron pipe, except that which is under basement floor, shall be standard cast-iron pipe; pipe under basement floor shall be extra-heavy cast-iron pipe. All pipe shall be of the diameters hereinafter called for, with the maker's name and the weight stamped on each length; to be sound, cylindrical, and smooth, free from sand holes, cracks, and other defects, and coated inside and out with coal tar.

All joints in cast-iron pipe are to be made with hand-picked oakum and soft pig lead, using 12 ounces of lead to each inch of diameter of pipe; lead to be thoroughly calked into joints. All joints between lead and iron pipe to be made by means of heavy brass ferrules wiped onto the lead pipe and calked into hubs of iron pipe.

150. Wrought-Iron Pipe.—All wrought-iron pipe shall be lap-welded, galvanized, puddled wrought-iron pipe, either Reading or Byers make. All fittings to be galvanized, malleable-iron beaded fittings. All joints in wrought-iron pipe to be screw joints made up with red lead, and the burr formed in cutting shall be reamed out.

151. Brass Pipe.—All brass pipe shall be seamless drawn, semi-annealed brass pipe, iron-pipe size.

152. Lead Pipe.—All lead pipe must be best quality of D lead, of the diameters hereinafter called for.

153. Excavating and Refilling.—The contractor for the plumbing shall do all excavating and refilling that may be required to install and complete all his work. He is to do it so as to interfere as little as possible with the work of other contractors.

154. House Sewer.—The contractor shall install the house sewer where directed. It shall be of vitrified salt-glazed pipe with hub and spigot joints, 6 inches in diameter. All joints shall be made by means of oakum gaskets and filled with one-to-one cement mortar, care being taken to remove all surplus mortar as the pipe is laid. Sewer shall connect with the house drain and run to and be connected with the sewer in street.

155. House Drains.—The contractor shall install the house drains where shown on the plans. They shall be 4 inches in diameter, of cast iron, as hereinbefore specified, and shall run from the soil stacks and connect with the house sewer.

156. House Trap.—The contractor shall locate the house trap just inside the basement wall. It shall be a cast-iron running trap 4 inches in diameter, provided with two cleanouts with brass screw-caps.

157. Fresh-Air Inlet.—From the house side of house trap, the contractor shall run a fresh-air inlet 4 inches in diameter; it shall

be carried 15 feet from the house and be finished at the grade with a return bend.

158. Soil Stacks.—The contractor shall install all soil stacks, as indicated or described, to connect with fixtures. Stacks shall run from the house drains up to and through the roof, and be properly flashed with heavy sheet lead. They shall be of cast iron, as hereinbefore specified, and 4 inches in diameter.

159. Branch Wastes.—All branch wastes shall be of either cast iron, D lead, galvanized wrought iron, and, where exposed, of nickle-plated brass. They shall be of the following sizes: Watercloset bends, 4-inch lead; bath tubs, 2-inch galvanized wrought iron; laundry trays, 2-inch galvanized wrought iron; sinks, 1½-inch galvanized wrought iron; lavatories, 1½-inch galvanized wrought iron.

160. Venting.—The contractor shall vent all closet bends and traps back into soil stacks. Vent lines shall be 2 inches in diameter of lead and cast iron for closet bends, and 1¼ inches in diameter of galvanized wrought iron for traps.

161. Leaders.—The contractor shall connect all rainwater leaders into the house drains, installing cast-iron running traps, at the foot of each leader. Traps shall be the same size as lines. Leader lines from the traps to the house drains shall be of cast iron, as hereinbefore specified, 3 and 4 inches in diameter.

162. Floor and Area Drain.—The contractor shall install floor and area drains in the floor of boiler room and in the area at the basement entrance. They shall be of cast iron 3 inches in diameter, provided with running traps and signet combined floor drains and traps, and shall discharge into house drain.

163. Refrigerator Drain.—The contractor shall install refrigerator drain where shown in kitchen closet. It shall be of galvanized wrought-iron pipe, as hereinbefore specified, and shall waste into sink in laundry where shown. Furnish and set where shown a galvanized-iron Cleveland refrigerator trap with 1½-inch branch waste connected to the refrigerator waste.

164. Piping.—All piping shall be run as direct as possible, avoiding unnecessary bends and turns. No piping, whether shown on the plans or not, shall be run so as to interfere with the proper installation of the work of the other contractors, and such piping shall be altered to run as directed by the architect.

165. Test.—The contractor shall properly test his work; all lines to be water-tested after they are installed, and all leaky or imperfect joints made tight. On completion of the work, it shall be smoke-tested in the presence of the architect.

166. Temporary Supply.—The contractor shall make temporary connections with the street main for use during the building operations; to have a sufficient number of outlets to satisfy the general contractor.

167. Supply.—The contractor shall make proper connections with water main in street. From this connection he shall run a 1¼-inch diameter standard galvanized-iron water supply provided with an iron body gate valve set in a cast-iron service box, brought up level with the curb and provided with a wrought-iron T-handle operating rod. This supply shall connect with the meter hereinafter specified, and shall run into the house at a point convenient for distribution.

From this main take off necessary branches, where directed, to hose connections, ¾ inch in diameter; to hot-water system, ¾ inch in diameter; to laundry and servants' toilet, ¾ inch in diameter; to boiler supply, ½ inch in diameter; to kitchen, ½ inch in diameter; to pantry, ½ inch in diameter; to toilet, ½ inch in diameter. Run rising mains ¾ inch in diameter to each bathroom.

From the various branch supplies and from the rising mains, take off branches ½ inch in diameter for each laundry tray, bath tub, and shower bath; and ⅜ inch in diameter for each watercloset tank and lavatory.

All supply pipe, except the exposed supplies to fixtures, which will be of nickel-plated brass, shall be of galvanized wrought iron. All branch lines shall be provided with proper stop and waste cocks, so placed that any one line or group of fixtures may be cut off without affecting the rest of the system.

168. Meter.—The contractor shall install 1¼-inch water meter where directed. Main supply shall have proper flanges to receive the meter.

169. Hot-Water Supply.—The contractor shall install a complete hot-water system, furnishing and connecting up heater and storage tank, complete. Where shown in kitchen, install a 60-gallon, two hundred pound test Brown & Brothers, cold-drawn seamless-copper range boiler. Boiler shall be connected with the waterbacks in the kitchen range, and in the laundry stove, and with a stack gas heater No. 3 located in the kitchen.

Cold-water supply to the boiler shall be ¾ inch in diameter. From the boiler run ¾ inch in diameter hot-water main, taking off branch supplies, ½ inch in diameter to laundry and servants' toilet in basement, ½ inch to kitchen sink, ½ inch to pantry, and ⅜ inch to toilet under the main stairs.

Run rising mains ¾ inch in diameter to two bathrooms in the second story, and ½ inch in diameter to servants' bathroom. From

these branch supplies and rising mains take off branches ½ inch in diameter to supply each bath tub and shower bath, and ⅜ inch in diameter to supply each lavatory.

Run circulating line ⅜-inch in diameter from the extreme end of hot-water system back to boiler.

All hot-water supply pipe shall be brass, and all exposed supplies to fixtures shall be nickel-plated.

All branch lines shall be provided with stop and waste cocks, so that any one line or group of fixtures may be cut off without affecting the rest of the system. Hot-water boiler shall be provided with draw-off and sediment cocks.

170. Hose Connections.—The contractor shall furnish and set two hose bibb sill cocks where directed, one on the front of the house and one on the rear. Hose bibbs shall be ¾ inch of approved pattern, flanged, polished brass, and they shall be provided with stop-and-waste cocks, at the foot of lines, so that the lines may be cut off and drained.

FIXTURES

171. The contractor shall furnish and install the fixtures hereafter mentioned where shown on the plans.

172. Water Closets.—Three (3) J. L. Mott Company's Silentum quiet-acting siphon jet waterclosets, No. 9 seats and covers with No. 2 cellu-enamel white finish, and nickel-plated bar hinges, No. 77 vitreous-china tanks with china lever handles, flush connections finished white, and No. 8 brass floor flanges, with china caps. Plate No. 5,332-A. These are to be placed in the toilet in first story and in owner's two bathrooms in second story.

Two (2) J. L. Mott Company's Lawrence wash-down siphon waterclosets, No. 9 birch-stained mahogany seats and covers with nickel-plated bar hinges, No. 79 vitreous-china tanks with china lever handles and No. 8 brass floor flanges with china caps, Plate No. 5,336-A. These fixtures are to be placed in the servants' toilet in basement and servants' bathroom in second story.

173. Bath Tubs.—One (1) J. L. Mott Company's Pomona Class B imperial porcelain bath 5′ 6″ long, glazed outside white, with Paxton concealed supply and waste fittings, (nickel-plated bell supply) 8½-inch nickel-plated shower head with arm to wall, control valves for bath and shower with 4-inch arm china index handles and china escutcheons, nickel-plated curtain rod with sateen curtain and nickel-plated chain and hook. Plate No. 2,732-A. This fixture is to be placed in the bathroom between bedrooms Nos. 2 and 3.

One (1) J. L. Mott Company's Putnam Class B imperial porcelain bath 5′ 6″ long, fitted as above specified with shower, etc. Plate No. 2,731. This fixture is to be placed in bathroom off bedroom No. 3.

One (1) J. L. Mott Company's Layton enameled-iron 3-inch roll-rim bath 5′ 0″ long, painted one coat outside, fitted with nickel-plated Harlem compression faucet, nickel-plated Harlem 1⅜-inch connected waste and overflow, chain and rubber stopper, and ½-inch iron-pipe size supply pipes. Plate No. 2,683-E. This fixture is to be placed in servants' bathroom in second story.

174. Lavatories.—Two (2) J. L. Mott Company's Altoona vitreous china lavatories 27″×22″ with vitreous-china standards and china wall supports, No. 8 Primus compression combination supply and wastes with gooseneck spouts (four-arm china handles and china escutcheons) and 1½-inch nickel-plated half **S** traps with iron-pipe size wastes to walls. Plate No. 4,222-A. These fixtures are for the owner's two bathrooms in second story.

One (1) J. L. Mott Company's Vermont vitreous-china corner lavatory with integral back, vitreous-china standard and painted-iron wall supports, nickel-plated Reliance waste, Trent low-down faucets with four-arm solid-china handles and 1½-inch half **S** traps with iron-pipe size waste to wall. Plate No. 4,223-A. This fixture is to be placed in the toilet in first story.

One (1) J. L. Mott Company's Bromley, enameled-iron lavatory 24″×18″, with integral back and apron, patent overflow and depressed soap dish, Lalor low-down compression faucets, nickel-plated plug and chain, 1¼-inch half **S** trap to wall. Plate No. 4,228. This fixture is to be placed in the servants' bathroom on second floor.

One (1) J. L. Mott Company's Balfour enameled-iron corner lavatory, 16½-inch size, with integral back and apron, patent overflow, and depressed soap dish, Lalor low-down compression faucets, nickel-plated plug and chain, 1¼-inch half **S** trap to wall. Plate No. 4,230. This fixture is to be placed in servants' toilet in basement.

175. Sinks.—One (1) J. L. Mott Company's Burnside enameled-iron kitchen sink with integral apron, right and left drainboards and back 6′-6″×22″, concealed wall hanger, adjustable enameled-iron legs, nickel-plated waste strainer and coupling, nickel-plated Belknap ½-inch combination supply faucet with china nameplates and 1½-inch half **S** trap with iron-pipe size waste to wall, and three wood mats for drainboards and sink. Plate No. 7,136-A. This sink is to be placed in the kitchen.

One (1) J. L. Mott Company's Plymouth tinned-copper pantry sink 24″×18″ with oak casing, ash top, and drainboard, nickel-plated legs, Italian marble back, Simplex standing waste and overflow, nickel-plated Belknap ½-inch combination supply faucet with china

nameplates and nickel-plated 1½-inch half **S** trap with iron-pipe size waste to wall. Plate No. 7,135-A. This sink is to be placed in the pantry where shown.

One (1) Standard Sanitary Manufacturing Company's 12"×18" porcelain enameled flat-rim kitchen sink, with nickel-plated flat strainer horn and follower, set on wrought-steel brackets, to set six feet above floor, to waste through 1½-inch cast-iron **S** trap and 1½-inch wrought-iron waste. This sink is to be placed in laundry, where shown, for refrigerator waste. Plate No. P-7,030.

176. Wash Trays.—One (1) Standard Sanitary Manufacturing Company's porcelain enameled roll-rim laundry tray (three sections) with body and back of each section in one piece, set on painted adjustable sanitary pedestals, with nickel-plated union strips and hardwood wringer holders. Fitted ½-inch adjustable flange compression side-handle bibbs, nickel-plated soap dishes, waste plugs and rubber stoppers, 2-inch galvanized wrought-iron continuous wastes, and 2-inch cast-iron **P** traps to wall. Plate No. P-7,320-E. These trays are to be placed in laundry where shown.

177. Medicine Cabinets.—Two (2) J. L. Mott Company's white-enameled steel-recessed medicine cabinets, with plate-glass mirror doors and three adjustable plate-glass shelves each. Plate No. 3,914-A. These cabinets are to be placed in owner's bathrooms in second story, where shown.

GAS PIPING

178. The contractor shall pipe the building for gas, running the necessary piping to supply the range outlet in kitchen, the water-heater outlet in kitchen, the light outlet in kitchen, the outlets in laundry, the light outlet in boiler room, and the outlets in both fireplaces. All piping shall be done in strict accordance with the rules of the gas company.

All pipe shall be of standard galvanized-iron or mild-steel pipe, with malleable-iron beaded fittings. Pipe shall be run regularly and in a workmanlike manner, using all necessary fittings and in no case springing or bending the pipe to reach a desired point. Pipe and pipe fittings shall be put together with red lead or litharge. Gas-fitters' cement will be allowed only at the outlet caps. All pipe shall be run level where possible, and where necessary to be pitched, shall grade down toward the riser and shall be without traps. Install proper drips at the bottoms of risers where directed.

Pipe shall be properly supported, using wrought- or malleable-iron pipe straps and hangers. Where pipe is run on the top of floor joist, it must be run not over three feet from the end of joist.

The gas company will make proper connections and run house mains of sufficient size into the building, and will provide a brass stop cock just inside the basement wall.

From the meter side of service the contractor shall run mains, taking off all necessary risers and branches. No risers shall be less than ¾ inch in diameter, and no branch less than ⅜ inch in diameter. Connections for gas range must be ¾ inch in diameter. All outlets must be capped.

After the lines are installed, the entire system shall be tested for a period of one hour, with an air pressure equal to fifteen inches of mercury. The mercury during the test must not drop more than one-quarter of an inch.

ELECTRIC WIRING

179. Scope.—The purpose of these specifications is to include a complete wiring system from the lighting company's service to each and every outlet throughout the building, including service switch, feeders, distributing panels, circuit wiring, plug receptacles, etc. All the work is to be done in strict accordance with the plans and these specifications, and in a manner satisfactory to the architect.

180. Code Rules.—The work shall be done in strict accordance with the rules and regulations of the National Board of Fire Underwriters and of the local department having jurisdiction, and the contractor shall obtain all necessary certificates at his own expense and deliver them to the architect before the work is accepted.

181. Guarantee.—The contractor shall guarantee to make good any defects in his work which may develop within one year from the date of acceptance.

182. Materials.—All materials used in the carrying out of these specifications shall bear the inspection label of the National Board of Fire Underwriters, and be acceptable to the local departments having jurisdiction. When no make or brand is specified, or where the expression, *or equal*, is used, the contractor must notify the architect of the make or brand to be used, and receive his approval before any of said material is installed. Where a particular brand or make is distinctly specified, no substitution will be permitted without the approval of the architect.

183. Test.—On completion of the work, the installation shall be entirely free from grounds and short circuits. A thorough test shall be made with a magneto in the presence of the architect or his representative.

184. Cutting and Repairing.—The contractor shall do all cutting necessary for the proper installation of his work, and shall repair any damage done by him or his workmen, employing the services of the contractor whose work is damaged, when so directed by the architect.

185. Light-Wiring System.—The circuit wiring shall be installed as a three-wire 110-220 volt single-phase, 60-cycle alternating-current system, and not more than 16 outlets with a maximum of 660 watts shall be placed on any one circuit. All wiring shall be installed as a concealed knob-and-tube system.

NOTE.—In case flexible-steel armored conductors are used, the last sentence should read: All wiring shall be done with flexible-steel armored conductors.

186. Installation of Wires.—(If knob-and-tube system is used.) All wires shall be rigidly supported by porcelain insulators that separate the wires at least 1 inch from the surface wired over. All wires passing through floors, studding, etc., shall be protected with porcelain tubes, and, where wires pass vertically through the bottom plates, bridging, etc., of partitions, an extra tube shall be used to protect the wires from plaster droppings.

Wires must be supported at least every four feet, and where near steam or water pipes, extra supports shall be used. All porcelain material shall be nonabsorptive, and any broken or damaged pieces must be replaced. Tubes shall be of sufficient length to bush the entire length of hole.

At outlets the wires shall be protected by flexible tubing, the same to be continuous from the nearest wire support to the inside of outlet box. All wire installed in masonry shall be protected by means of approved rigid-iron conduits, which must be continuous from outlet to outlet. Install a ground conductor from one wire of the system to water system, or to an approved ground connection, as may be required by the inspection department having jurisdiction.

(If flexible-steel armored conductors are used.) All runs must be rigidly secured in place by means of pipe straps, and where they terminate in outlet or panel box, an approved box connector with locknut and bushing shall be used. Care must be taken that the rubber insulation is not damaged, or rough cutting edges remain when the armor is stripped.

No bends shall be made with an inside radius of less than 4 inches, and conductors must be securely fastened out of contact with gas, water, or other pipes. If necessary, each and every run of conductor must be thoroughly grounded with a mechanically and electrically perfect connection to the water system on the street side of the meter. At least one point of the system shall be grounded in this way. If the water system is not available, install an approved ground connection. Install a ground conductor from one wire of the system to

Electric Outlets

Location	Wall	Ceiling	Drop	Base	Switches	No. of Lights
Basement						
Boiler room		1			1 in hall	2
Entry			1			1
Laundry		1			1	2
Laundry (power)	1				1	200 W.
Hall		1			1 3-way	1
Dark closet			1			1
Vegetable cellar			1			2
Drying room			1			2
Toilet	1					2
First Floor						
Vestibule		1			1 in hall	2
Hall		1			2 3-way	3
Hall				1		3
Hall	1					3
Hall (telephone)	1					
Toilet	1					2
Living room		2			2	8
Living room	2				2	4
Living room				3	3	12
Living room				1	1	2
Side porch	2					4
Side porch		2				6
Side porch				2		4
Dining room		1			2	4
Dining room	2					4
Breakfast porch		1			2	4
Coat closet	1				Door swinging	1
Pantry			1			2
Hall (rear)					1 3-way to basement	1
Hall	1					1
Kitchen	1					1
Kitchen		1			1	2

Electric Outlets (Continued)

Location	Wall	Ceiling	Drop	Base	Switches	No. of Lights
Kitchen					1 3-way to 2d floor	1
Kitchen			1			1
Service porch		1			1 in kitchen	1
Kitchen closet			1			1
Rear porch		1			1 in hall	3
Second Floor						
Hall		2			1 3-way	4
Hall (telephone)	1					
Bedroom No. 1	2					4
Bedroom, No. 1				2		4
Bedroom, No. 2	2					4
Bedroom, No. 2				1		4
Bathroom	1					2
Bedroom, No. 3	2					4
Bedroom, No. 3				1		2
Bathroom off bedroom No. 3	1					2
Rear hall	1				1 3-way with 3-way in kitchen	1
Rear hall	1					2
Rear hall					3-way to 3d floor	
Servants' bedroom No. 1	2					4
Servants' bathroom	1					2
Sleeping porch	1					2
Third Floor						
Hall	1				3-way to 2d floor	1
Hall	1					1
Servants' bedroom No. 2	1					2
Trunk room	1					1
Cedar room	1					1

water system or to an approved ground connection, as may be required by the inspection department having jurisdiction.

187. Outlet Boxes.—Outlet boxes shall be standard pressed-steel knockout type, and shall be galvanized (enameled). Boxes shall be rigidly secured in place, and those intended for fixtures shall be provided with a fixture stud.

188. Position of Outlets.—Unless otherwise directed and indicated, all plug receptacles shall be located in the baseboard. Wall brackets shall be 5 feet 6 inches above finished floor, except where they come over lavatories or furniture, where they shall be 6 feet 6 inches above finished floor. Wall switches shall be 4 feet above finished floor. The center of all bracket outlets shall be located not less than three inches from the edges of the back band of door and window trim. All outlets shall be centered with regard to paneling, furring, trim, etc., and any outlets that are improperly placed must be corrected at the contractor's expense. All outlets must be set plumb, and extend to the finish of wall, ceiling, or floor, as the case may be, without projecting beyond the same.

A list of all the outlets in the building is given on pages 122 and 123.

189. Conductors.—Conductors shall be continuous from outlet to outlet, and no splices shall be made, except in the outlet boxes. No wire smaller than No. 14 B. and S. gauge shall be used, and for all circuits of 100 feet or longer, No. 12 B. and S. gauge shall be used. All conductors of No. 8 B. and S. gauge, or larger, shall be stranded. Wires shall be of sufficient length at outlets to make connections to apparatus without straining connections.

Splices shall be made both mechanically and electrically perfect, and the proper thickness of rubber and friction tape shall then be applied.

190. Grade of Wire.—All wire shall be of copper, with not less than 98 per cent. conductivity. The insulation shall be of rubber with protecting braids, and all wire must be in the original coils and bear the underwriters' label.

191. Local Switches.—Local wire switches shall be single-pole toggle-flush type, with beveled-edge brass coverplates finished to match the surrounding hardware. Switches shall be either Hubbell, Bryant, or General Electric make. All switches shall be wired to break on the live side of circuits. Where more than one switch occurs in the same location, furnish an approved gang plate to cover all switches.

192. Plug Receptacles.—All plug receptacles shall be of the Spartan type, duplex, either Bryant, Hubbell, or General Electric

make, with beveled-edge brass covers to match the surrounding hardware.

193. Three-Way Control.—The outlets in hall, first story, and in stair hall in basement, first, second, and third stories shall be controlled by three-way switches, where shown.

194. Hardware.—All hardware furnished under this contract shall match in quality and finish other adjacent hardware.

195. Service Switch.—The service entrance switch shall be an externally operated service switch of the full capacity of house feeder; to be either a Krantz Autolock Safety Switch or Square D safety switch, to be provided with meter-test links and meter trim for the size of meter which will be used in this installation.

196. Distributing Panel.—The distributing panel shall consist of two-wire porcelain base dead-front panelboard units.

197. Panel Cabinet.—The distributing panel cabinet shall be of steel, not less than No. 12 gauge, bent up, and flanged. Distributing panel shall be surrounded with a slate partition ½ inch thick which shall form a wire space around panel.

198. Panel Trim and Door.—The panel trim and door shall be of steel with brass-cylinder lock and concealed hinges. A directory of circuits served by the panel shall be enclosed in glass with metal frame, mounted on the inside of panel door.

199. House Feeder.—The size of the feeder from the service switch to the panelboard shall be figured in accordance with the National Code Rules for carrying capacity, allowing for all circuits being fully loaded. The feeder shall be of sufficient size, however, to confine the drop in voltage with all lights in circuit to one per cent. of the line voltage.

200. Service Connections.—The contractor shall install service feeder, of the same size as house feeder, from the lighting company's line to the service entrance switch, and make all connections complete, including all excavation and refilling, to the satisfaction of the lighting company and the architect. Feeder shall be installed underground in galvanized-iron pipe conduit. Wires shall be lead-covered and the outside of conduit shall be painted with asphaltum. Make all provisions for the installation of meter, as may be required by the lighting company.

CALL BELLS

201. The contractor shall furnish, install, and connect all push buttons, bells, buzzers, and annunciators as shown on the plans and herein described.

All wiring shall be cleated in joists, studs, etc., with insulated staples. Damp places, metal pipes of all descriptions, flues, etc., must be avoided, and wire fastenings must be applied in such a way that insulation is not damaged. No splices shall be made where same will not be accessible at any time after the completion of the building, and all splices shall be thoroughly taped.

Wires shall not be smaller than No. 18 B. and S. gauge, and shall be damp-proof insulated.

Annunciators, bells, buzzers, buttons, etc., shall be of approved make and acceptable to the National Board of Fire Underwriters and the local department having jurisdiction.

Push buttons for entrance doors shall be provided with plates to match the hardware of doors. Interior push buttons shall be Western Electric Company's Midget type No. 620, with light pearl center, and finished to match the hardware in the rooms in which they occur. Push buttons for dining room shall consist of combination floor push with necessary length of cord and approved portable foot push.

Furnish and install where directed one (1) Western Electric Company's No. 1 bell-ringing transformer.

SCHEDULE OF BELLS

202. The contractor shall furnish and install the following bells to ring as directed: Front-entrance door, rear-porch door, service-porch door, living-room doors, breakfast-porch door; three bedrooms in second story, all to ring in annunciator in kitchen.

CONDUIT FOR TELEPHONE WIRES

203. From a point of entrance approved by the telephone company, install ½-inch galvanized rigid-iron conduit to telephone locations, where shown in halls, providing bushed openings at each end of conduit.

HEATING

204. Scope of Work.—This specification is intended to cover the installation of a low-pressure vapor-vacuum direct and indirect system of steam heating, complete with boiler, piping, radiators, ducts, valves, etc., including all excavating and refilling in connection with the heating plant.

The system must be guaranteed to heat the entire house to a temperature of 70° F. when the temperature outside is 0° F. If, after the first winter that the system is used, it does not give the required results, the contractor must make the changes necessary to produce these results without extra cost to the owner.

205. Test.—The contractor shall thoroughly test the entire system, before turning it over to the owner. Boiler shall be blown down several times while under pressure, for the purpose of removing any core sand, oil, or other foreign substances that may have found lodgment in it. After testing, the contractor shall remove the interior from all radiator traps and air-valve traps, and the cover from the air eliminator, and thoroughly clean all the interiors, after which the devices must be properly reassembled.

206. Boiler.—The contractor shall install in the boiler room where shown on the drawings, one American Radiator Company's Ideal S-25-5 (catalog number) sectional cast-iron boiler 800 square feet of radiation, or Hart & Crouse Company's Royal S-22-5 (catalog number) sectional cast-iron boiler 800 square feet of radiation. Boiler shall have steam and water gauges, pop safety valve, automatic damper regulator, and be provided with a complete set of firing tools. The contractor shall put in ashpit and all foundations required for the boiler.

207. Smoke Pipe.—The boiler shall be provided with a smoke pipe of the proper size. It shall be of No. 16 gauge sheet iron fitted with a properly pivoted damper attached to damper regulator. All connections in smoke pipe shall be made perfectly tight.

208. Pipe and Fittings.—All pipe shall be black wrought-iron pipe (Byers or Reading) of standard weight, and all fittings shall be standard cast-iron fittings with perfect threads. All piping must be reamed out after cutting, to give the full size of pipe, and it must be well rattled to remove all dirt and scale.

All joints in pipe shall be made perfectly tight without the use of red lead, cement, or other compounds. Pipe must be put up in the most secure manner, with extra heavy hangers properly arranged to allow for expansion and contraction.

All mains, both supply and return, must be run at least 30 inches above water line of boiler, and be as much higher than that as is possible. All mains shall be properly graded. Grade shall not be less than 1 inch in 15 feet.

Flanged unions must be placed at suitable points to allow for disconnection for repairs.

All supply and return risers shall be run concealed, and ample provision must be made for expansion and contraction, so that there will be no lifting of the radiators.

All run-outs from risers to radiators shall be made under the floor, and must be given a grade of 1″ in 3′ 0″ back to risers. Run-outs must be one size larger than the radiator valves and traps.

209. Valves and Traps.—All valves, except on direct radiators, shall be the best quality of the renewable-disk type, either Jenkins Brothers or Fairbanks make. Valves shall be the same size as pipes and connections. All valves over two inches of iron body shall have brass mountings, and all valves of two inches and under shall be of brass properly finished and polished. All valves on the lines shall be gate valves.

Each direct radiator shall be equipped on the supply end with the proper size of modulation valve, either Warren Webster & Company's, C. A. Dunham Company's, or Illinois Engineering Company's make, and the return end of each direct radiator shall be equipped with ½-inch thermostatic trap, either Warren Webster & Company's, C. A. Dunham Company's, or Illinois Engineering Company's make.

The supply connection to each indirect radiator shall be provided with a full-size gate valve, and the return connection vented through a thermostatic trap, either Warren Webster & Company's, C. A. Dunham Company's, or Illinois Engineering Company's make, and an approved type of swing-check valve.

For the purpose of removing the air from the end of the supply main, where it drips into the wet return main, install a thermostatic trap of the same make as the radiator traps.

210. Radiators.—All radiators shall be as follows: All floor radiators shall be American Radiator Company's Peerless, or other approved make plain-surface cast-iron radiators. Wall radiators shall be American Radiator Company's Peerless wall radiators hung on Sico adjustable wall brackets.

All indirect radiators shall be of the Perfection pin type, 10 square feet per section.

All radiators must be of the hot-water type, with connections at the top and bottom and at opposite ends. In no case shall the tops of floor radiators project above the window sills. The contractor must verify the heights of window sills from the floor and make any changes necessary to prevent it.

In setting indirect radiators, care must be taken to see that both sides and ends of radiators come in contact with the casings to prevent the passage of air other than directly through the radiator. A space of at least 10 inches must be provided above the top of radiator, and at least 8 inches below the bottom of radiator to give a free circulation of air. The fresh air must be delivered at the under side of the radiator, at the opposite end from which the warm air is taken. The warm air must be delivered to the register from the top at the opposite end of the radiator from the supply.

Radiators must be set at least 30 inches above the water line of boiler, and as much higher than that as is possible.

All air-valve tappings on all radiators shall be omitted, or the outlets shall be plugged with iron plugs.

All radiators must be thoroughly cleaned of all core sand, etc., before leaving the factory, and provided with loose wooden plugs, which must be left in the radiators until they are connected to the various pipe lines.

211. Air Eliminator and Return Trap.—For the purpose of separating the air from the condensation water discharged into the dry return piping, the contractor shall furnish and install a return trap of the proper size of either Warren Webster & Company's, C. A. Dunham Company's, or Illinois Engineering Company's make. Trap must be set not less than 10 inches above the water line of boiler.

212. Sheet-Metal Work.—The contractor shall furnish and erect all sheet-metal work required in connection with the indirect radiators, which shall include radiator casings, cold- and warm-air connections, damper, etc. All ducts shall be constructed so as to eliminate any undue friction; all turns and bends shall be made with easy curves, and all joints shall be made air-tight. All ducts shall be made of No. 24 United States Standard gauge heavy galvanized iron, constructed with flat seams to reduce the friction in the air flow to a minimum. Each cold-air duct to indirect radiators must be provided with a volume damper so arranged that it may be locked in any position.

Clean-out doors shall be provided at suitable points in all ducts.

Openings in the outside walls of basement for the fresh-air intake will be provided by the mason contractor, but this contractor shall furnish and set in these openings brass screens of a mesh to be selected by the architect.

213. Floor Registers and Grilles.—The contractor shall furnish and set floor registers in living room and dining room where shown, of the sizes marked on the plans, and grilles in the seat in living room and under stairs in hall. Floor registers shall be of cast iron, plain-lattice design, electro-bronze plated, and shall be equipped with

louvre dampers. Grilles shall be No. 12 gauge perforated-steel ⅛-inch mesh electro-bronze plated. Registers and grilles shall be properly secured in place.

214. Protection.—All woodwork shall be protected in accordance with the rules of the National Board of Fire Underwriters. Where pipes pass through floors or stud partitions, they shall be provided with galvanized sheet-metal thimbles 1 inch larger than the pipe, and shall have nickel-plated floor and ceiling plates. Where pipes pass through concrete walls, they shall have wrought-iron thimbles. All thimbles and plates must be fastened to the piping in such a manner as to prevent them from slipping out of place.

215. Covering.—The boiler shall be covered with 1½-inch thickness of plastic asbestos, applied in successive layers, while the boiler is hot. Covering must be securely wired to the boiler, after which a finishing coat of asbestos cement ½ inch thick must be applied and troweled to a smooth, hard finish. After the covering has become thoroughly dried, the whole surface must be covered with a heavy canvas securely pasted to the boiler covering.

All piping in boiler room and basement shall be covered with Johns-Manville four-ply Asbestocel covering. All risers and radiator run-outs shall be covered with two-ply asbestocel covering. Covering for pipes must include all branches, fittings, etc. The ends of runs of all covering must be sealed. Fittings may be covered with plastic material or with pre-cast covering. All covering shall be properly cemented, strapped, and fastened and covered with heavy cotton duck, and painted two good coats of lead and oil paint. All concealed pipes must be covered before any lathing is done.

216. Painting and Bronzing.—All exposed ironwork in the basement, including the boiler front, shall be given two coats of best air-drying Japan varnish. All exposed piping and radiators above the basement shall be given one coat of bronzing liquid, and three coats of lead and oil paint to match the color of woodwork in the rooms in which they occur. All painting must be done while the heating apparatus is warm.

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SPECIFICATION-WRITING MEMORANDA

BUILDING ERECTION, CONSTRUCTION, AND EQUIPMENT

1. Introduction.—The writing of specifications in which are described all the necessary data pertaining to the erection, construction, and equipment of buildings, is a very important matter. The following memoranda are for the assistance of the writer of specifications, enabling him to find, without delay, much necessary data stated in a brief and concise manner.

MASON CONTRACTORS' WORK

EXCAVATION

2. Depth of Footings.—The depths of footings should be regulated by the nature of the soil and the depth to which the frost penetrates in the locality, and should be shown on the drawings. The contractor should go deeper if the soil proves unsafe to build on at the depth specified, and the specifications should so provide. The contractor would of course receive extra compensation for such work and should notify the architect when such an occasion arises, in order that a record may be kept of the extra amount of excavation that is done.

3. Width of Trenches.—The width of trenches, etc., for masonry should be not less than 8 inches wider each side than the actual dimensions of walls or piers, so that the mason may be able to point properly the faces of the wall as it is built. The widths of trenches are usually governed by the widths of the footings, which are proportioned according to the weight they are to carry.

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4. Foundation Beds.—When rock suitable to build on is encountered, it should be stepped in level beds where necessary to receive the walls, and all hollow spots should be filled with concrete.

Sand forms a good foundation bed if confined laterally.

Clay, when hard and dry, is usually a good bed, but if damp and on a slope, it is treacherous unless it is confined, as it is liable to slide.

Gravel forms a good foundation bed; is easily leveled, and if reasonably dry, has a large bearing power.

Made ground should never be trusted to carry any great amount of weight, and, if it is possible, the excavation should be carried through this soil to a firmer one; but if this is not possible, the walls should be carried on thick concrete footings that are so spread as to distribute widely the weight.

5. Uniformity of Foundation.—Foundations should be so constructed that the pressure on the soil under footings shall be well within the safe-bearing power of the soil at all points; or if this is impossible, so that the settlement will be uniform at all points. Great care should be bestowed on the examination of the bottoms of the trenches, in order that soft spots, etc., may be removed and the holes filled with concrete. If a very large spot should occur in an otherwise good foundation, it should be spanned with a reinforced-concrete lintel or a brick arch springing from the abutting footings.

6. Water in Excavations.—If water is encountered in any quantity, provision should be made to lead it away from the walls by means of terra-cotta drains. This is very important and the strength of the foundations is often greatly dependent on this precaution.

7. Drainage of Footings.—To drain the footings, a line of porous terra-cotta pipe or agricultural tile with butted joints is placed at the base of the footings. This pipe or tile should be laid with a pitch of not less than $\frac{1}{4}$ inch to the foot, and should have the joints wrapped with asphalted burlap or felt. The trench is usually filled above the pipe, to within a foot of grade, with broken stone, brick, or similar material. Unless a large spring is to be drained, the line of pipe may safely be run to some convenient distance from the building and the water allowed to soak away into the surrounding soil by means of a stone pit. If the soil is impervious, or the amount of water is excessive, some outlet other than a stone pit should be provided.

8. Sheet piling is used in soft and treacherous soils to keep the trenches open during the laying of walls, and to protect the banks of open excavations. Sheet piles are either of wood or steel, are flat and are driven side by side against the bank of the excavation, forming a continuous partition to prevent the spreading of the soil. Wooden sheet piling is jointed either by butting or by matched edges. For excavations up to 16 feet deep,

2-inch plank may be used; for excavations up to 24 feet deep, 3-inch plank should be used, and for deeper excavations, 4-inch plank should be used.

Sheet piling in open excavations should be braced by means of inclined shores with foot blocks and wedges, and in trenches should be held in place by means of short lengths of plank run from side to side of the trench and wedged tight. Steel sheet piling is rolled specially by several steel mills and comes in several sizes and weights. It is made interlocking and the joints may be filled with plastic material. Steel sheet piling may be withdrawn or filled around with concrete to make a permanent bulkhead, as in sidewalk vaults, etc.

FOUNDATIONS

9. Piling.—Where a soft yielding soil is encountered and the footings cannot be spread to keep within the safe bearing power of the soil, piling must be resorted to. If the water level is constant and the footings are below water level, wooden piles may be used, but if there is a changing water level, and the footings are well above the normal water level, concrete piles are better and generally more economical. Concrete piles are of two general types; those molded in place and those molded before driving.

10. Common Tests for Stone.—Stone is commonly tested for compression and absorption. For compression, the crushing value is seldom less than $2\frac{1}{2}$ tons and sometimes reaches 20 tons per square inch. The crushing value and weather-resisting qualities are usually greater in stones of a crystalline character than in those of an amorphous character; and the bearing power is greatest when laid on the natural bed. The safe working values for these stones are from one-tenth to one-thirtieth of the values just given.

A simple test to determine the crystalline properties of stone can be made by placing a few chippings in a glass of clear water. If, after being agitated briskly for a few moments, the water shows no muddiness but remains perfectly clear, it may safely be inferred that it is a good crystalline stone and is suitable for building purposes, providing its resistance to compression is ample and its absorption value is not excessive.

11. Durability of Stone.—The durability of stone can usually be judged by the foregoing tests, but observation of actual examples in buildings of such stones as are to be used is very essential to safe results.

The atmosphere of large cities often contains gases that are due to bituminous-coal smoke and other vapors from large manufactories. These gases have a great affinity for water, and when combined with rain water, or mist, they form very weak acids that have a detrimental effect on marbles and limestones. Before using such stone in localities where these gases are given off, observations should be made to determine whether such stone has already been used there, and if so, to find

out the age and condition. The finish of the different surfaces of the stonework used in a building should be clearly specified.

High temperatures will permanently injure almost all building stones, but up to 800° F. the average good building stone will not be materially injured.

12. Footing Stones.—The footing stones should be as large as possible and should be laid on their natural beds. They should be well bedded in cement mortar. As the footings are under the greatest pressure, they should be of the hardest stone obtainable.

PLAIN CONCRETE

13. Building Sand.—Good sand should consist of a mixture of coarse and fine grains, with the coarse grains predominating. Not more than 20 per cent. should pass a No. 50 sieve and not over 5 per cent. a No. 100 sieve. Sand should be composed of hard, angular, coarse grains and it should preferably be of silicious materials, free from dust, clay, loam, vegetable matter, and salt. Sea and river sands are not as sharp as bank sand and, except where a clean white mortar for plastering is desired, they should not be used. As sand is largely distintegrated rock, crushed granite or quartz screenings make excellent sand for all purposes, except for the white coat in plaster.

14. Testing Sand.—Sand should be tested very carefully on important work, in a properly equipped testing laboratory. Under ordinary circumstances a simple test for clay or loam may be made by putting a quantity of sand in a clear glass bottle, then filling the bottle with water nearly to the top, thoroughly shaking the sand and water together, and allowing the mixture to settle for a few hours. By measuring the column with a rule, it is a simple matter to find the percentage of the dirt on the top in relation to the sand underneath, and if there is 5 per cent. or over of clay or loam in the sand, it should be rejected or else washed clean of sand and loam before using.

15. Aggregates for Concrete.—The nature and relative amount of aggregates used for concrete has much to do with the final strength of the mixtures. Aggregates are classified as fine and coarse. Fine aggregates are either natural sand or rock screenings, while coarse aggregates are either natural gravel, crushed stone, or by-product materials such as crushed blast-furnace slag or cinders. Crushed stone is generally considered better than gravel as an aggregate. Granites, trap-rocks, and limestones are generally used. Blast-furnace slag is hard but porous, has high compressive strength, and on account of its rough pitted surface, gives good adhesion for cement, but care should be taken to see that the sulphur content is low. Cinders should only be used in inferior grades of mass

concrete and for fireproofing, as they have low structural strength, high porosity and usually a high sulphur content.

Aggregates should be carefully graded and care should be taken in selecting them; first, to see that they do not contain objectionable impurities in their substance; and, second, that they are clean, particularly the gravel, which is liable to have a coating of clay that will prevent the adhesion of the cement.

16. Lime.—Quicklime is a calcined material, the major part of which is calcium oxide or calcium and magnesium oxides, which will slake on the addition of water. It should be picked practically free from ashes, core, clinker, or other foreign material, but may contain a maximum of 5 per cent. of silica, aluminum, and oxide of iron. Quicklime is sold either screened, that is, with the fine material removed, or unscreened, that is, without the fine material removed. It is shipped in two sizes; lump, which is kiln size; and pulverized, which has been reduced to pass a No. 3 sieve.

Lime should not be used where any moisture is encountered, but may be used in brickwork above grade, for plastering, whitewash, etc. Lime is now tested and inspected according to rules established by the American Society for Testing Materials, and is therefore thoroughly standardized.

17. Hydrated Lime.—A lime which has been slaked at the place of manufacture is called *hydrated lime*. It is a dry, fluffy powder and can be mixed directly with the sand without slaking. Hydrated lime may be used for any of the purposes for which quicklime is used; also, it is mixed with Portland cement concrete for waterproofing purposes.

18. Cement.—When cement mortar has been mixed, it should be used at once, as setting commences as soon as cement has been wet. Freezing weather will not harm Portland cement mortar, if the mortar can be kept from freezing until setting has commenced. The addition of salt to the water used in the mortar and heating the sand and water before mixing will retard freezing.

Very good cements are manufactured from a mixture of granulated basic slag and hydrated lime. These cements are not generally as strong or reliable as Portland cement, but, on account of setting slower and making a fatter mortar, they are excellent for laying brick.

Portland cements are manufactured and tested according to the standard specifications of the American Society for Testing Materials, and should be specified that it meet these requirements.

19. Cement Qualities.—Cements are usually tested for their setting and hardening qualities, strength under tension and compression at different ages, and also for specific gravity and fineness.

20. Waterproofing Concrete.—Concrete, especially when used for foundation walls and basement floors, should be made sufficiently water-

tight to exclude ground and rain water, and be dense enough to reduce absorption to a minimum.

There are a number of integral waterproofing compounds on the market, most of which are good and may be specified with safety. In all cases they should be used according to the manufacturer's directions to obtain the best results. In almost all cases, one of the best waterproofing materials is hydrated lime added to the concrete. In adding hydrated lime, no variation in the proportions of the other ingredients should be made, the lime being added as an additional ingredient, and as an admixture instead of as a replacer of cement. The maximum amount of hydrated lime which may be added to the various mixtures of concrete is as follows: 1–2–4 concrete—10 lb. of hydrated lime to each bag of cement; 1–2½–5 concrete —12 lb. of hydrated lime to each bag of cement; 1–3–6 concrete—16 lb. hydrated lime to each bag of cement.

Another method of waterproofing walls is the membrane method which is described in Art. 52.

21. Proportions for Concrete.—Concrete is generally mixed in the proportion of one part of Portland cement, two parts of fine aggregate, and four parts of coarse aggregate for reinforced work or where a particularly strong concrete is needed; one part of Portland cement, two and a half parts of fine aggregate and five parts of coarse aggregate for a strong concrete for machinery foundations; one part of Portland cement, three parts of fine aggregate and six parts of coarse aggregate for footings, foundations and walls.

22. Mixing Concrete.—Concrete may be mixed either by machine or by hand. Machine mixing is undoubtedly the better, as it gives a much more uniform quality of concrete and is less expensive, except where a very small quantity of concrete is to be used. When concrete is mixed by hand the materials should be mixed together dry, then wet, and then thoroughly mixed together after wetting.

23. Precautions for Using Cement Concrete.—Cement concrete should be used as soon as mixed, and in hot weather it is a good plan to sprinkle the concrete lightly from time to time—just enough to keep the surface wet. This will retard the shrinkage somewhat and prevent surface cracks.

24. Nailing Concrete.—A number of compounds are now on the market which, mixed with Portland cement and sand, make a concrete into which nails can be driven and provide a holding power equal to that of wood. These nailing concretes, the principal ingredient of which is, in many cases asbestos, are rapidly displacing the more or less unsatisfactory floor sleepers and cinder fill which are used to hold wood floors laid over concrete floor slabs. These nailing concretes are also put on roof slabs of either concrete or book tile, and slate or tile are nailed directly thereto without the use of nailing strips.

25. Placing Concrete for Footings.—Concrete should not be thrown from a height greater than 4 feet, as the larger and heavier portions, or aggregate, thereby become separated from the sand and cement, and the concrete will be uneven in its composition and strength.

26. Tamping Concrete.—Concrete, whether used for footings, floors, beams or columns, should be thoroughly tamped immediately after being placed in position. It should have the stones spaded back from the forms to give the mortar finish to the face, and be puddled to work out all air bubbles. Tamping should not be too prolonged, as it will affect the strength of the concrete.

27. Size of Concrete Footings.—The depth of concrete footings should not be less than 8 inches and should be proportioned in area according to the weight to be placed on them.

28. Safe Loads on Concrete —The average safe loads per square foot for Portland-cement concrete, 12 months old, composed of one part cement, three of sand and six of broken stone, are from 15 to 25 tons.

29. Concrete foundation walls should be built between forms made up of either matched boards or boards with the edges dressed to a slight bevel to make tight joints. Boards should be free from knot holes and should be properly braced and tightened up with tie wires to prevent bulging under the weight of the concrete. Concrete should be poured in layers of not less than 6 inches nor more than 12 inches at one time. The upper surface of each course should be left rough to form a key for the succeeding course, and, if allowed to set and dry before the next layer is poured, should be well wet, and, if necessary, slushed with cement mortar composed of one part of cement and two parts of sand. Concrete makes a much stronger wall than one of brick or stone of the same thickness. The exposed surfaces of concrete walls may be molded, plastered, or given a tooled finish as may be desired.

30. Thickness of Concrete Cellar Floors.—Concrete floors for areas or cellars should be not less than 5 inches in thickness, with a top coat of strong cement mortar troweled to a smooth surface. This coat should be not less than 1 inch in thickness and should be applied as soon as possible after the under coat is laid.

31. Dividing Concrete Floors Into Blocks.—Where there is no danger of water working up through the floor, it is well to lay the concrete in separate blocks with paper between the joints, so that these blocks will be entirely independent; this reduces the effects of shrinkage. Where the floor is not so divided, it is good practice to cut a deep joint subdividing the top coat only into blocks as stated. Natural and artificial cements should not be used for two adjacent coats, as they will not adhere to each other. The same cement should always be used for such coats.

32. Hardening Concrete Floors.—It is often found necessary to harden concrete floors, especially in engine rooms, factories, and warerooms where cement dust, caused by trucking, etc , rises from the floor and causes damage to machinery and to merchandise. Hardening is done either by mixing a metallic hardener, generally powdered iron, with the top coat of the floor, using about 30 pounds of hardener to each 100 square feet of floor; or by liquid hardeners, which are fluosilicates of magnesium and zinc, applied to the surface of the floors.

33. Damp Walls.—A damp wall cannot usually be made permanently dry by an inside surface coating. Such expedients at their very best almost always give only temporary relief. The best way to get rid of dampness in walls is to remove its cause.

34. Openings in Concrete Floors.—After the floors are constructed, openings are often cut for pipes, etc. This is liable to weaken the floor and should be avoided if possible by taking special care to have all necessary openings left when the floors are being built. But if these openings are necessary afterwards, they should be no larger than is absolutely necessary and should be well boxed with iron.

35. Chases in Walls.—Care should be taken to leave chases in walls for pipes. Any bolts that may be necessary for fastening woodwork, should be built into the concrete.

36. Reinforcement in concrete consists either of rods or bars of round or square section. Rods or bars, except those used for stirrups in beams and column reinforcement, should be a deformed bar, of which there are a number of different types rolled, so as to obtain a positive mechanical bond between the steel and concrete. Mesh and expanded-metal reinforcements are generally used in slabs, sewers, etc. Mesh reinforcement is either electrically welded or woven. Rib-metal laths of heavy-gauge sheet steel also are used for reinforcing concrete slabs laid over steel beams.

37. Concrete-Floor Construction.—Concrete-floor construction consists of reinforced slabs of concrete placed between steel or reinforced-concrete beams, or between masonry walls. The reinforcement is obtained in various ways by steel of different shapes being so placed as to take up the tension and to assist in resisting the shearing stresses of the mass. The most common types of floor slab are the mesh reinforced slabs using welded or woven mesh for reinforcing; slabs reinforced with square or round bars, and ribbed slabs composed of hollow tile with reinforced-concrete ribs 4 inches wide between each row of tile and a thin slab of concrete over the tile, or dome-shaped steel forms set between the ribs.

It is possible, by thickening the concrete and increasing the amount of reinforcing, to make solid concrete slabs span up to 15 feet and ribbed slabs span up to 25 feet, although excessively long spans are not desirable on account of weight and added cost.

The advantages of concrete-floor construction, aside from its fire-resisting quality, are lightness and relative cheapness; short-span floor slabs weighing from 40 to 60 pounds per square foot. The main points to watch in concrete-floor construction are improper construction and bracing of forms, the use of inferior cement and aggregates, improperly mixed concrete, and the misplacement of the reinforcing. When properly constructed, a reliable concrete-floor system makes a strong, light, fire-resisting floor.

COMMON BRICKWORK

38. Technical Names of Bricks.—The technical names adopted by brickmakers are confusing and differ in almost every state, but the bricks in common use may be roughly classed as follows: Pressed, vitrified, paving, fire, enameled, and common bricks.

39. Brick Colors.—The color of common bricks depends entirely on the nature of the clay from which the bricks are made. Iron, magnesia, and other substances are used to color pressed brick and a great many shades can now be obtained.

40. Sand-Lime Bricks.—A brick composed of finely ground sand and lime is now being manufactured.

41. Slag Bricks.—Bricks made up from basic blast-furnace slag are being manufactured in a number of steel-manufacturing centers. These brick are as yet in an experimental state and require the test of time to prove their value.

42. Absorption of Brick.—The absorption of a brick should not be more than 10 per cent. of its weight.

43. Mortar Mixing.—Mortar should be mixed in special water-tight boxes, which should be kept as clean as possible. This insures the exclusion of earthy matter. Mortar should never be mixed on the ground.

44. Mortar for Brickwork.—Cement mortar should be used where the brickwork is under considerable weight or where it is below ground or for chimneys above the roof.

Lime putty and sand make the best lime mortar for brickwork.

45. Proportions for Mortars.—Proportions for lime mortar and cement mortar vary somewhat, but good practice calls for 1 to 3 for lime mortar, and 1 to 3 for Portland-cement mortar. Two and one-half per cent. of lime putty or hydrated lime added to cement mortar makes it work easier, enabling the bricklayer to make a neater job. A good proportion for lime-cement mortar is 1 part of lime putty, 1 of cement, and 6 of sand.

46. Freezing Mortar.—To avoid freezing mortar, it is advisable to heat the sand and water, and to mix only enough mortar for immediate

use. A larger proportion of cement should be used than in warm weather. The walls may also be enclosed by tarpaulins, and temporary heat supplied until the mortar has set.

47. Laying Brickwork With Lime Mortar.—In freezing weather, laying brickwork with lime mortar should not be allowed, if it is possible to avoid it; but if the work must be done, the mortar should be made in small quantities, with freshly slaked lime and warm water, and used at once, or treated as described in Art. **46.**

48. Wetting Bricks.—It is very essential that all brick laid in warm weather should be well wet before laying, because the bricks will be better bedded in the mortar under them. The bricks will adhere to the mortar better, and will not absorb the moisture from the mortar. Care should be taken, however, to see that the brick are not wet to a point where they will slip out of place when laid in the mortar.

49. Mortar Joints in Brickwork.—The mortar joints in brickwork exert considerable influence on the strength of the brickwork, and are the weakest part of the wall. Brickwork laid in lime mortar is probably about three-quarters as strong as that laid in cement mortar. Imperfectly mixed mortar or joints not well filled up lessen the strength of the brickwork. Mortar in the joint is much stronger than in cubes under a testing machine.

50. Efflorescence on Brickwork.—Efflorescence is a very difficult blemish to prevent or to remove permanently and the chemistry involved in the production of the salt or salts that are to blame is difficult to establish. Chemists suggest that, before burning, the bricks be immersed in dilute hydrochloric acid, the strength of the solution to be inversely proportional to the amount of lime in the clay. This is claimed to be efficacious. Where a wall is already built and a method of keeping the efflorescence from reappearing after once being washed off is desired, painting with boiled oil or some paraffin preparation is suggested; this should render the surface of the brickwork impervious to moisture. Successive coats of alum and soap solution are also said to be useful.

51. Coating Brickwork.—The coating of brickwork with boiled linseed oil is done to fill the pores, thus preventing absorption of foreign substances.

52. Waterproofing Brick Walls.—Brick walls below grade can be waterproofed in a very satisfactory manner by the membrane method of waterproofing. The same method may be applied to stone or concrete walls.

This method consists of mopping the outside surface of the walls with either hot asphalt or coal-tar pitch, and applying roofing felt over this surface, lapping the joints at both the ends and edges, then mopping with hot asphalt or coal-tar pitch. Membrane may be made in one-ply, two-

ply, or more according to the water pressure, five-ply being the thickest membrane generally used. Basement floors may be waterproofed by the membrane method and the membrane carried out under the walls and bonded with the membrane on the walls. After applying the membrane 4 inches of brickwork should be laid on the outside of walls to protect the membrane when the refilling around walls is done.

A number of bituminous preparations are sold. These can be brushed on the walls and are very effective if there is no great amount of water pressure.

53. Flue Linings.—All chimney flues should be lined their entire height with terra-cotta flue lining made in the following sizes (outside dimensions): $8\frac{1}{2}''\times8\frac{1}{2}''$, $8\frac{1}{2}''\times13''$, $13''\times13''$, $13''\times18''$, and $18''\times18''$. All openings in flues for smoke pipes should have terra-cotta thimbles. Large flues for boilers should be lined with firebrick laid in fireclay for at least the first 25 feet of their height.

54. Smoke flues not terminated by a fireplace should be extended to an accessible distance from the cellar floor and provided with a cast-iron clean-out frame and door similar to that used for ash-pits.

55. Chimneys in outside walls should have the flues protected from the chilling of the outside air and consequent stoppage of circulation, by having at least an 8-inch wall in addition to the customary terra-cotta lining.

56. Chimney Tops of Terra Cotta.—Terra-cotta chimney tops are manufactured in many styles, some of which are very decorative. These tops may be used to extend the height of the flues to remedy a smoking fireplace or may be used simply as a decorative feature.

57. Chimney Tie-Rods.—Tie-rods are used to anchor tall chimneys to roofs. The exposed ends of these rods are often finished with some decorative feature such as a shield or rosette. Tie-rods and the anchors of floor joists are recognized decorative features in the Netherlands, Germany, and England.

58. Fireplace Throats.—Throats for fireplaces should be carefully constructed, and should be no larger than is necessary for the passage of the products of combustion into the flue. The throat should be provided with a shutter by which to regulate the size of the opening; it should also include a shelf to catch the falling soot, which may be cleaned off from time to time. Cast-iron combination throats and dampers are made, which are properly proportioned for various sizes of openings. These have proved very satisfactory and are used in the best class of work.

59. Smoky Fireplaces.—A smoky fireplace is not always due to improper proportions of the fireplace itself, but often to an insufficient supply of air from the room or to down drafts of deflected air from sur-

rounding roofs when the top of the chimney is too low. The remedies for both cases suggest themselves. The sectional area of flues is usually made one-tenth to one-fifteenth the area of the fireplace opening.

60. Brick Mantels.—Brick mantels are used in the best work, and bricks especially for this purpose are manufactured by some concerns. Ordinary pressed bricks, and even common bricks, however, in the care of a good designer, are capable of receiving very satisfactory treatment for this purpose.

61. Furring for Brick and Stone Walls.—The furring for brick and stone walls may be either hollow bricks of the same size as regular bricks, which may be bonded into the wall and into which nails may be driven to fasten trim, etc., or split furring tile made the same as partition tile described in Art. **77**, and secured to the walls either by driving 10-penny nails into the joints in brickwork, the heads bent down over the tile, or by means of heavy wire ties built into the joints in brickwork. Laths or wooden bricks are often built into brick walls to afford nailing for wood furring on which the laths are placed. Stone walls are plugged with wood for the same purpose, but the hollow bricks or split tile, though more expensive, are to be preferred.

62. Corner Anchors.—Where side and front walls are built up separately and tied together by means of toothed offsets, they should have corner anchors 3 feet long, of $1\frac{1}{2}'' \times \frac{3}{8}''$ metal, bent up 4 inches at the one end and fitted with a $\frac{3}{4}$ inch diameter rod 12 inches long at the other, to be built into the side walls as the walls are being laid up, to be spaced every 3 feet in the height of the walls.

63. Floor-Joist Anchors and Hangers.—Steel and malleable-iron hangers are now made that are built into the wall and tie the joist to it by means of a lug at the bottom of the hanger, which engages into the bed of the beam. These hangers are made in many types. They should allow free circulation about the end of the joist, in order to prevent dry rot.

FACE BRICK

64. Pressed Bricks.—The interior walls of public buildings are now frequently lined with pressed bricks, which take the place of a plaster wall at little additional cost. This lining of pressed bricks makes a much more durable and lasting surface.

65. Molded Bricks.—Almost every profile and ornament in the form of molded bricks are now manufactured and when properly used they give very satisfactory results. Bricks should be examined to see that they are true and that their beds are not too smooth, as this gives no clinch for the mortar.

66. Enameled bricks are made in many varieties and are suitable for such uses as bathrooms, swimming pools, kitchens, light wells, etc. They should be laid in Keene's cement colored to match the enamel.

67. Flemish and English Bond.—Bonds in brickwork are used only on face walls for decorative effect. Flemish bond consists of alternate headers and stretchers in each course, and English bond is laid up with a course of headers and a course of stretchers. These bonds are not popular with the bricklayers and the work must be watched carefully to insure the headers being directly over each other. In laying brick in Flemish or English bond the headers in every sixth course should be full headers; all other headers may be half brick.

68. Bricks for Pavements.—Bricks on edge for pavements in stables, court yards, etc., are preferable to stone, and should be laid in cement mortar and well grouted with neat cement.

69. Cleaning and Pointing Walls.—The work of cleaning and pointing stone or brick walls is usually done at the same time. The cleaning consists of removing dirt, stains, dust, pieces of mortar, etc. It should be done with soap powders dissolved in hot water, clean white sand and plenty of clean water, and stiff fiber brushes. Wire brushes and acids should never be used, as they destroy the face of the brick or stone. Pointing is done by raking out the joints in stonework and any defective joints in brickwork and filling with a special mortar. A good pointing mortar may be mixed in the proportions of one part non-staining cement, two parts clean white sand, and sufficient cold lime putty to make a mixture as stiff as can be worked.

STRUCTURAL TERRA COTTA

70. Terra cotta is a burnt-clay product and is of two classes: Ornamental or architectural terra cotta, which is used for wall facing and trim on the exterior of buildings and sometimes for interior decoration; and structural terra cotta, which is used for floor arches, partitions, furring, columns, fireproofing, etc.

71. Structural Terra Cotta.—Structural terra cotta, or hollow tile, as it is generally called, may be made from either clay or shale. It may be dense, semiporous, or porous, very hard burned or vitreous, standard hard burned, medium burned, or soft. Porous terra cotta is made by the addition of saw dust or other combustible material to the raw clay, producing a tile that can be nailed into.

72. Terra Cotta for Heavy Loads.—Structural terra cotta, being hollow, should be filled with concrete where it is required to carry any great weight. Where this is done, care should be taken to wet the terra cotta before filling.

73. Hollow-Tile Walls.—Exterior walls may be built of terra-cotta blocks called hollow tile. Tile should be either a very hard-burned or standard hard-burned terra cotta. Hollow-tile exterior walls are generally stuccoed, but a very good type of wall is one face with 4 inches of brick or stone and backed up with hollow tile, bonding the brick or stone into the tile walls by the use of back-up tile, which are narrow, thin tile allowing the brick headers to bond between the courses of full-sized tile.

74. Terra-Cotta Arches.—The different types of terra-cotta arches for floor construction are either of porous or of dense terra cotta. The dense terra cotta is the stronger and is used for arches. The porous terra cotta is to be preferred for partitions and is used for grounds to which the trim, etc., may be nailed directly. The porous terra cotta offers more resistance to fire than the dense.

75. Methods of Building Arches.—Terra-cotta floor arches are built in three ways, by the *end method*, by the *side method*, or by the *combination method*. The combination method is generally considered the best.

76. Depth of Arches.—The depth of terra-cotta floor arches varies from 6 to 15 inches, according to the span and the load that is to be carried. The New York Building Laws require $1\frac{3}{4}$ inches in depth for every foot of span, not including any terra cotta below the bottom of the beam.

77. Partition terra-cotta blocks are made 2, 3, 4, and 6 inches thick. Porous and semiporous tile are used for partitions, and door and other openings should be arched. These partitions are often reinforced with metal rods or with horizontal trussed wire built in the joints. Three-inch blocks are suitable for ordinary partitions, which should not be higher than 12 feet. Four inch blocks are suitable for corridor partitions, which should not be higher than 14 feet. Six-inch partitions should not be higher than 20 feet. These blocks are set with their cells vertical.

RUBBLE-STONE MASONRY

78. Rubble Masonry.—All rough masonry should be laid as level as possible, with the stone laid on its natural bed. Walls should have through stones to every 5 to 10 square feet of wall surface. Work should be well filled with mortar and all chinks or interstices filled with spalls or small stones well driven into the mortar. Joints on the faces of walls should be left open for pointing on the completion of the work.

79. Ashlar facing should be well bonded into rough backing, either by alternating thin and thick courses of sufficient depth or by tying each stone with galvanized-iron or copper anchors doweled into the facing and built into the backing.

CUT-STONE WORK

80. Staining of Limestone.—Ordinary cement will stain limestones, marbles, and some granular sandstones. All such stone should be laid up in lime mortar or a non-staining cement mortar, and the backing directly behind the stone should be laid in the same mortar as the stone is laid. As an extra precaution, it is a good practice to plaster the back of all stone with setting mortar. There are a number of non-staining cements on the market, La Farge cement, manufactured in France being one of the oldest and best known. A number of white Portland cements and white slag cements, which are quite as good as the imported cement, are now manufactured in this country and are much easier to obtain. "Atlas White," "Medusa White," and "Magnolia White" are some of the better known brands.

It used to be considered good practice to paint the backs and edges of stones with damp-resisting paints, but the best authorities now condemn this practice as doing more harm than good.

81. Carving of stone is usually done from plaster or clay models that have been approved by the architect.

82. Protection of Carved Work.—Where there is danger of the finished work and carving being damaged, protection should be provided by strongly boxing the stone with rough white-pine boards. Hemlock or any resinous wood should not be used, as it is liable to stain the stone.

83. Patching Carved Work.—Patches are sometimes placed in carving where it has been damaged. The right to remove promptly such work should be reserved to the architect in the specifications. These patches are often very difficult to detect, as the stone is usually covered with a fine dust, which hides such patches. They may be easily detected, however, by wiping the carving with a wet rag. These patches should not be allowed to remain, as they are likely, in time, either to drop out or to become noticeable.

ARCHITECTURAL TERRA COTTA

84. Architectural terra cotta is molded, jointed, and modeled either to imitate stone, or as a separate and distinct material. It is finished with either an unglazed finish or a glazed or enameled finish. The colors may be buff, gray, salmon, red, or brown, in the unglazed finish, and white or the various colors in the glazed finish. The glazed finish may be either lustrous or mat glazed. The surfaces of the terra cotta may be either smooth or tooled. It is now possible to give terra cotta a polychrome decoration as was done in Italy in the 15th century, using two or more colors, which may be separated by lines or blended. It can also be fire-gilded, which is a gold glaze fixed by additional burning. The great advan-

tage in the use of terra cotta, especially in tall buildings, is the fact that it is almost the only material in which both lightness and strength are combined.

85. Qualities of Terra Cotta.—The ideal terra-cotta clay contains about 70 per cent. of silica and 30 per cent. of alumina.

The percentage of absorption of terra cotta should not be more than 10 or 12 per cent., or acids in the atmosphere and the action of frost will have a deleterious effect on it. Therefore, the more dense terra cotta is the better it will be for ornamental work.

A well-burned piece of perfectly sound terra cotta will ring clear when struck.

86. Disadvantages of Using Terra Cotta.—The chief disadvantage in using terra cotta is the difficulty of avoiding shrinkage, which causes uneven lines in cornices, etc. The delivery of terra cotta is usually very uncertain, and for this reason it is well to place orders for the material as early as possible.

87. Drawings for Terra-Cotta Work.—The detail drawings for terra cotta are usually made from the architect's small-scale elevations and sections by the manufacturer's draftsmen, who make due allowance for shrinkage. Each block has a certain mark put on it that agrees with that on the setting drawings, which enables the foreman to locate it readily on the work. This practice is common with cut stonework also.

88. Terra-Cotta Models.—Models for ornamental terra cotta should be submitted to and approved by the architect. These models are usually made to a scale of 13 inches to the foot in order to make proper allowance for shrinkage.

89. Shrinkage of Terra Cotta.—The shrinkage of terra cotta compels the making of sills, cornices, etc., in pieces short enough to reduce any irregularities to a minimum. Such pieces where exposed to the weather should be lapped at upper-surface joints.

90. Chiseling of Terra Cotta.—Chiseling the face of terra cotta to get a better joint, etc., should not be allowed, as this will expose the more porous material under the vitrified surface to the action of the atmosphere and will look badly besides.

91. Setting Terra Cotta.—Ornamental terra cotta should be set in Portland-cement mortar, and should be well anchored to the backing and provided with dowels, rod reinforcing, angles, etc. All ironwork used for anchoring and stiffening terra cotta should, wherever possible, be galvanized, as plain iron will rust and streak the face of terra cotta.

92. Pointing.—The pointing of ornamental terra cotta should be done with Portland cement colored to match the color of the terra cotta.

93. Protecting Terra-Cotta Work.—The protection of ornamental terra cotta before and after setting is an important matter, and should be strictly enforced, as it is very difficult to replace broken pieces except after considerable delay and trouble. It is often impossible to remove broken pieces from their places in the building without damage to the other construction.

TERRA-COTTA FIREPROOFING

94. Salt-glazed terra cotta is a very hard-burned dense tile of either shale or fireclay, which is glazed by the introduction of common salt into the kiln while hot. The salt vaporizes, forming a glassy coating on the exposed surfaces of the tile. Salt-glazed terra cotta is used for sewer pipe, wall copings, and, in some cases, for exterior wall construction.

95. Column Fireproofing.—Steel columns should be encased with hollow tile at least 3 inches thick securely anchored to the structural framework. Tile should be bedded in cement mortar and the channel spaces in **H**-shaped columns should be filled with tile fillers.

96. Book Tile.—Roof or ceiling blocks, also called *book tile*, are 2 and 3 inches thick and are used on pitched roofs. They are supported on steel **T**'s.

97. Gypsum Blocks.—Hollow blocks for partitions, column fireproofing, and furring are made by a number of manufacturers. These gypsum blocks are in most cases 12 inches by 30 inches in area and 2, 3, 4, 5, 6, and 8 inches in thickness. The great advantage claimed for them is their lightness, being considerably lighter than the terra-cotta tile. The only disadvantage is that if they get soaked with water they dry out very slowly; and if they are very badly soaked, they are liable to disintegrate.

FURRING AND LATHING

98. Wood Lath.—The standard sizes for wood lath are $\frac{3}{8}'' \times 1\frac{1}{2}'' \times 48''$, 36", and 32" long. Lath are graded by the manufacturers as No. 1 and No. 2 lath. Laths are sawed from practically all the various kinds of wood used for framing timber and rough lumber which includes yellow pine, white pine, Norway pine, spruce, tamarack, and cypress, and should be specified according to local market conditions. For the best results use No. 1 lath which admit of the least defects. Lath should be put on $\frac{3}{8}$ inches apart for plastering with quicklime, $\frac{1}{4}$ inch apart for plastering with hydrated lime and patent plasters, and from $\frac{1}{4}$ to $\frac{3}{8}$ inch space should be left between the ends of laths. Joints should be broken every seventh lath and no lath should be put on vertically. The thicker lath, if there are any, should always be used on the ceiling, as more strength is required

there than on the side walls. Wood lath, when delivered at the buildings, should be properly protected from rain or snow.

99. Metal lathing is used extensively on metal studding and also on wood studding over heat flues, behind tiling or where greater strength or fire-resisting quality than wood lath affords, is required. A number of kinds of metal lath are on the market, the most common of which are wire cloth and the various types of expanded metal. Lath may be had either galvanized or painted. The minimum weights which should be allowed to be used should be 2.20 pounds per square yard, for plain lath on walls, with studs 12 inches on centers; 2.5 pounds per square yard for plain lath on walls, with studs 16 inches on centers; 3 pounds per square yard for plain lath on ceilings with joists 16 inches on centers; and 3 pounds per square yard for $\frac{3}{8}$-inch ribbed lath on supports placed 24 inches on centers for exterior work. Lath should be well stapled or nailed to the studding, etc., and, where patent plaster is used, nails or staples should always be galvanized.

100. Lathing Nails.—The nails used for lathing are generally of iron—cut or wrought—and should not be smaller in size than four-penny nails. Three-penny nails are sometimes used, but are too small for good work. Copper or zinc nails are quite expensive, but make a much better job, as they will neither rust nor discolor the plaster.

PLASTERING

101. Lime for Interior Plastering.—The lime used for interior plastering should be a quicklime. It should be fresh and properly burned and should contain not more than 5 per cent. of ashes, core, clinker, or other foreign material. Lime for base coats should be run off through a No. 8 sieve after slaking and should be allowed to stand at least 2 weeks before using. Hydrated lime is also used for plastering and has one great advantage over quicklime, that it does not need slaking and consequently does not have to be stored, but can be put on as soon as it is mixed.

102. Lime for white coat should be run off through a No. 10 sieve after slaking and should be allowed to stand not less than 2 weeks, and longer if possible, until all the superfluous water has evaporated. Hydrated lime is also used for the white coat and a special finishing hydrate is put up by the manufacturers of hydrated lime.

103. Necessity of Preparing Sufficient Lime Putty.—If possible, sufficient lime putty should be prepared to do all the plastering required in the building. Sometimes, for various reasons, the contractor will not make enough lime putty for the whole building, and if the upper stories are plastered first, the supply may be exhausted long before the lower and

more important stories are reached. In this event, some fresh lime putty will have to be mixed, and the contractor, being generally urged to hurry the work along, may be tempted to use this new mixture of putty before it is thoroughly seasoned, with the evil results just mentioned.

104. Use of Sand in Plaster.—The use of sand in plaster is for the twofold purpose of regulating and preventing excessive shrinkage and to supply centers of crystallization. The fact that sand is cheaper than lime is sometimes a temptation for the contractor to put in too much sand. The usual proportion for good plaster—brown or scratch coat—is one part of lime to two parts of sand.

Sea and tidal-river sands should be avoided, as they contain a certain amount of salt, which is sure to discolor the walls and tends to keep them damp. All sand used for plastering in good work should be washed.

105. Gypsum or patent plasters are made up with a gypsum base and do not have to be slaked. As a result they are used to a great extent on large city buildings where it would be almost impossible to store enough lime putty to complete the work. The finished surfaces of this plaster are hard and can be polished. They also take paint well. Gypsum plasters are made *neat*, or without the admixture of sand. They are also made up mixed with the sand and fiber for the different coats and should always be applied according to the manufacturers' directions. Patent plasters should never be used on theaters or auditoriums, as their extreme hardness impairs the acoustics. Some of the better known brands used in the United States are Acme, Adamant, Texas, and King's Windsor.

106. Plaster of Paris is calcined gypsum. It is used for the white coat in plastering, where its great shrinkage is regulated by the addition of sand. It is also used for making what is called *composition ornament*, such as capitals, brackets, moldings, etc., and for *staff*.

107. Plaster Thickness.—The thickness of lime plaster on wood lath should not be less than $\frac{7}{8}$ inch and all grounds should be of that thickness. On metal lath or brick or tile walls, the lime plaster should be $\frac{3}{4}$ inch thick and the grounds should be of that thickness. Patent plaster on wood lath may be $\frac{3}{4}$ inch thick and the grounds should be of that thickness. Plaster should not be put on too thin, as it is liable to crack, due to too little strength to resist the inevitable shrinkage of the laths.

108. Number of Coats of Plaster.—In all good work plaster on lath, either wood or metal, should be put on in three coats, scratch, brown, and finish; and on brick or tile walls in two coats, brown and finish. In very cheap work, two coats, consisting of a first coat and finish coat, are allowed. The first coat is put on by applying a thin coat and then by doubling up on that coat and completing the job in practically one operation.

109. The Scratch Coat.—The first, or scratch, coat in ordinary plaster is composed of lime and sand in the proportion of one to two, with

cattle hair mixed in, about $1\frac{3}{4}$ pounds to each bushel of lime. Jute, Manila fiber, or other binders, are frequently used.

110. The Brown Coat.—The second, or brown, coat has a little more sand than the first coat, and about $\frac{1}{2}$ pound of hair to each bushel of lime.

111. The Finished Coat.—The third, or finished, coat is usually a *sand finish* or a *white coat.* The sand finish is composed of lime putty and washed white sand. The white coat is *fine stuff*, or screened lime putty mixed with a small amount of plaster of Paris or marble dust or both. Too much plaster of Paris will cause surface cracks. Lime putty containing plaster of Paris is called *gauged stuff.* Four parts of plaster of Paris and one part of sand or marble dust to twenty-four parts of lime putty is the usual proportion for the white coat. For the sand finish, sand takes the place of marble dust and plaster of Paris in the white coat.

112. Causes of Plaster Cracks.—Cracks in plaster are caused by shrinkage in the framework of the building; too little sand; the use of inferior materials; laying plaster on walls that are too dry; laying one coat on another before the under coat is properly set; and the mixing of too much plaster of Paris in gauged mortar.

113. Effects of Plaster Freezing.—If ordinary plaster becomes frozen, its usefulness is destroyed; some patent-plaster walls, if not frozen until 36 hours after being put up, are not harmed.

114. Plastering on Brick or Stone Walls.—Plaster placed directly on brick or stone walls will not obtain a strong bond with the wall unless the stone wall is rough or the joints in the brickwork are scraped out. If these walls have been wet during the construction of the building, they should be well dried out before the plastering is applied, although the surface should be dampened enough to prevent excessive absorption of water from the plaster, which will usually cause cracks, as mentioned in Art. **112.**

On solid brick walls, where the plaster is applied directly to the inner surface of the wall, the plaster is apt to be stained by moisture, due to rain storms, which permeates the walls and the plaster. Painting the surface of the wall with R. I. W. waterproof paint or some similar paint on which the plaster can be placed, will keep out the moisture. This paint should be put on carefully so as to cover all points of the wall surface. There is, however, some possibility of this paint hardening with age and finally decomposing enough to allow the passage of water. Nevertheless, in walls of this kind, it is the best method of keeping out the moisture, except, possibly, the oiling of the outer surface or coating with alum and soap solutions, which must be renewed every few years.

115. Plaster Stains.—The staining of the plaster on wooden laths is usually due to sappy knots, or sometimes to foreign matter that has found its way into the plaster because of an unclean mortar box. A separate mixing box should be used for the white coat.

On brick, terra cotta, or stone, it is harder to locate the causes, but the use of the R. I. W. paint or a similar coating will usually prevent such stains. The uncertainty as to the life of the coating is not so important here as where the passage of water is to be prevented, for the plaster will be past the danger of staining from these sources after a few weeks are past.

EXTERIOR PLASTERING

116. Exterior Plaster or Stucco.—Most authorities claim that the best exterior plaster for half-timber work, stucco, or hollow tile or brick is made up of Portland cement and sand with the addition of a small quantity of hydrated lime. Stucco should be three-coat work, except on very cheap buildings. The mortar for stucco should be composed of one part of Portland cement, three parts of clean, sharp sand and one-tenth part of hydrated lime.

Stucco may also be composed of about 11 cubic feet of lime paste to 27 cubic feet of sand, with the addition of 1 cubic foot of Portland cement to accelerate the hardening. Stucco made of these materials is known as *lime stucco*.

Magnesite or oxychloride cement is also being extensively used for stucco. Magnesite, or magnesium oxide, is mixed with magnesium chloride creating a chemical reaction which causes it to set. Magnesite stucco can be applied in the winter, as no water is used in the mixing. If magnesite stucco is used with metal lath the lath must be galvanized as magnesite is destructive to uncoated steel. The finish coat may have the surface finished by stippling, sand floating, rough casting, pebble dashing, or other methods, and may be colored by using colored sands, or by adding mineral pigments to the mortar.

117. Composition and **staff** are both made from plaster of Paris and hemp or other fiber, the difference being only in the amount of fiber. The amount of fiber used in staff is much more than that in composition, which is employed only for comparatively small pieces of ornament, especially interior work. These materials will not withstand a climate where there are sudden changes of temperature or where the temperatures are extreme, and the safest method, if used at all, is to confine it to interiors, but even here their brittleness is a great objection.

Very good column caps, panels, molding ornaments, etc., are now made of composition, and where the work is not to be from special designs, the stock designs may be specified by catalog number.

TILE, MARBLE, AND SLATE

118. Marble is used in interior work for floors, stair treads, door thresholds, enclosures around water closets and shower baths, and for fireplace facings and hearths. There are many varieties both of domestic and imported marbles on the market, but care should be taken that a fairly hard marble is selected, as some of the most beautifully veined marbles are very fragile.

119. Slate.—Structural slate is used for stair treads, enclosures around water closets and shower baths, urinal partitions and backs, sinks, and school blackboards. Black slate is most generally used, although it is possible to get green, purple, and red. Slate comes in clear stock and ribbon stock, and it is finished either by sand rubbing or hone finishing, the latter giving the best surface. The final treatment of water-closet enclosures, etc., is to give them a coat of linseed oil.

120. Method of Fastening Marble Slabs.—Marble slabs should be fastened in place by backing up with plaster of Paris and anchoring by means of copper or brass cramps, wires, or screws. Slabs should be anchored by the edge where possible. Exposed screws should be plated to match other hardware. All fragile marbles should be backed up either with slabs of slate or cheap strong marble.

121. Marble Cement.—A cement for marble can be made by soaking plaster of Paris in a saturated solution of alum, after which it is baked in an oven and then ground to a powder. This cement may be colored and, when in place, polished to imitate the marble with which it is to be used. This is practically a Keene cement.

122. Finishing Marble.—The usual methods of finishing marble is to polish all vertical surfaces which are not carved, and to hone finish all floor tile, thresholds, and floor slabs for shower baths.

123. Polishing Marble.—Alum for polishing marble is objectionable, and its use should not be allowed, as it fills the pores and makes the marble very susceptible to stain. Slabs can be tested for this by simply wetting them; this treatment will leave whitish spots when the water has dried.

124. Marble fireplace facings undergo slight expansion under moderate heat, and this must be taken into account in the jointing. Marble slabs expand about $\frac{1}{30}$ inch for every foot of their length at 230° F.

125. Scagliola, or Imitation Marble.—Artificial marble is now made of Keene's cement and coloring matter. It should not be used for floors, but if well made is acceptable for wainscoting, columns, cornices, etc., for inside decoration. Wainscot bases and plinths should be made of natural marble, as this will better withstand the contact of a mop, water, etc.

A white opalescent glass is now made, which as a substitute for marble is used for wainscoting, floor slabs, urinal stalls, etc.

126. Advantages of Artificial Marble.—The advantages of artificial marble are its cheapness, freedom from cracks and flaws, and the fact that it can be made in sizes and shapes that would be almost impossible or very expensive in real marble.

127. Kinds of Tile.—The various kinds of tiles used for flooring and walls are classified as ceramic, mosaic, vitreous, and semivitreous tiles, paving tiles, inlaid and quarry tiles, glazed tiles and enamels, and plastic tiles and faience.

Ceramic, mosaic, vitreous and semivitreous tiles, paving tiles, inlaid, and quarry tiles are generally used for floors and glazed tiles, and enamels, plastic tiles, and faience are always used for walls. Floor tiles are made square, oblong, octagonal, and hexagonal, except quarry tiles which are always square. Wall tiles are square, oblong, octagonal, and hexagonal, but the square and oblong are most generally used. Glazed tile are white, and enameled tiles may be almost any color or shade desired.

128. Marble mosaic floors are made up of small cubes of marble called *tesseræ*, bedded in Portland-cement mortar, well grouted and ground down either by means of carborundum wheels or by hand-rubbing with sandstones.

129. Terrazzo is a mosaic flooring made up of a matrix composed of marble chips of different colors and sizes mixed with Portland cement, spread on the floor slab or a setting base, then sprinkled with marble chips and ground down in the same manner as mosaic floors. A good terrazzo should show on the face at least 85 per cent. of marble. The base used with both these floors and the plinth blocks of the door trim should be of marble, so that the floors may be washed without the water coming in contact with the woodwork.

130. Setting Tile.—Floor tile should always be set on concrete setting beds, which should be 2 inches thick, except when set directly on earth or fill, in which case they should be 3 inches thick and be reinforced with a shrinkage mesh of either 16-gauge expanded metal of from 2 inches to 3 inch mesh, or a galvanized, rectangular mesh-wire fabric of No. 8 wire, 3 inches on centers, crossed by No. 10 wire 8 inches on centers. A mortar setting bed, not less than $\frac{1}{2}$ inch thick, should be laid over the concrete setting bed. Mortar should be composed of one part of Portland cement and three parts of sand. Tile should be set in this mortar bed, carefully leveled up and all joints grouted with Portland cement mixed with water, to the consistency of thick cream. Wall tile should be set on a scratch coat of cement mortar applied directly to brick or tile walls or on metal lath where stud partitions occur. Tile should be set in Portland-cement mortar and be set either by floating or by buttering. Joints in wall

tile should be filled with white Portland-cement mortar mixed with water to the consistency of thick cream.

131. Asphalt Flooring.—Flooring made of asphalt is impervious to water and is therefore a most sanitary pavement that is very suitable for stables, etc. It may be from ½ inch to 1¼ inches thick, depending on its use. The surface of the concrete foundation on which the asphalt is laid should be perfectly dry and free from dust when the asphalt is placed.

132. Tar Pavements.—Tar paving for courts, playgrounds, etc., should be used only on flat surfaces. This kind of paving is soft and agreeable to the tread, and is composed of heated gravel or broken stone about ⅜ inch in diameter mixed with boiling tar of a mixture of tar and asphalt. Where there is much traffic, two coats should be laid on a bed of concrete, the under coat being about 1½ inches and the top coat about ¾ inch in thickness.

133. Gutta-percha, or rubber, pavement is sometimes laid in hospitals, where quiet is essential, but its cost prohibits general use. It should be laid on a concrete base.

METAL TRADES

STRUCTURAL IRONWORK

134. Skeleton Steel Construction.—Where skeleton construction is used, after the general layout of the building has been determined on, a structural engineer is called in, who lays out the framing plans to suit the conditions of the design, figuring the weights and dimensions of the beams and columns and the sizes of their supporting piers and foundations, according to the loads they will have to carry.

135. Ordinary Construction.—In ordinary construction, where a steel beam to span an extra-wide opening is used only occasionally, or the structural work is of a simple character, the services of an engineer are hardly needed.

136. Beams.—The steel companies issue handbooks that contain tables which enable the architect or the engineer to pick out suitable steel beams for given conditions.

To avoid excessive deflection, the relation of the span to the depth of a steel beam should be as follows: Depth of steel beam, in inches, should not be less than one-half of the span, in feet. Where extra strength is required and the depth of a beam is limited, two beams bolted together may be used; or, if the depth is not an objection, a plate girder may be used.

137. Lintels over openings are generally composed of steel L's or in case of long spans, light channels, or I-beams.

138. Girders.—The depth of a plate girder should not be less than one-fifteenth of the span.

139. Bearing plates for beams or girders should set back slightly from the face of the wall, in order that there may be no tendency to crack or chip the corner from the brickwork or stonework. Where stone corbels are used for the bearing of steel beams or girders, they should for the same reason have the front edge chamfered.

140. Anchors.—Where the ends of steel beams rest on walls, they should always be provided with anchors. The common forms of anchors are the government anchor or the *bent spear* as it is sometimes called, which is a ½-inch rod bent up at the center and run through a hole in the end of the beam, the **T** anchor, which is similar to the anchor used for wood beams, and which is bolted to the web of the beam, and angle anchors which are two short pieces of steel angle riveted to the web of the beam, one on either side.

141. Steel Trusses.—For spanning wide spaces, steel trusses made of steel angles riveted together and reinforced with plates where necessary to obtain greater strength, may be built. For a given strength they are much lighter and cheaper than wood, and without the shrinkage and liability to dry rot.

142. Columns.—Cast-iron columns are suitable for ordinary work but the Bethlehem Steel Company rolls **H**-shaped column sections in sizes from 6 to 14 inches in a number of weights for each size, and the Carnegie Steel Company rolls **H** sections in 4-, 5-, 6-, and 8-inch sizes; the handbooks of the respective companies give the strength of the various sizes and lengths of these columns, which are in all cases better than cast iron and lighter in weight for the same strength. Columns may be built up of rolled-steel shapes, which, as a general rule, must be figured, although the handbooks give the strength of quite a number of built-up sections.

143. Strength of Columns.—Columns vary considerably in strength, according to the method of securing the ends. If both ends are fixed, the column will be much stronger than if both ends are loose or only one end fixed. The importance of firmly bedding column bases is therefore easily seen.

144. Wind bracing should be provided for in a building that is more than twice its least dimension in height.

145. Jambs and Saddles.—Cast-iron or steel-channel jambs and cast-iron saddles are used at elevator and other doors in warehouses, factories, etc., where there is considerable trucking. Jambs should always be anchored back into the brickwork.

146. Necessity of Painting Iron and Steel Work.—Structural cast iron or steel should be thoroughly painted before erection with a good brush coat of either red-lead or iron-oxide paint. As soon as it is erected, all scratched places, etc., should be touched up with the same paint, and the metal should then be given one or two good brush coats of graphite paint. Before applying the first cost of paint all scale and rust should be entirely removed, for if any particles remain they will cause the paint to peel off. This cleaning of the surface of iron or steel work is of the utmost importance but it is seldom done thoroughly. If the steel delivered at the building shows any signs of scale, etc., under the paint, it should be cleaned of both scale and paint and repainted. Where possible, the exposed structural steel and iron work should be painted every 3 to 5 years.

ORNAMENTAL METAL WORK

147. Metal Work.—In architectural work, ornamental metal work, outside of lighting fixtures and builders' finished hardware, includes cast- and wrought-iron work and cast bronzes or brass, and other metals.

148. Drawings for iron castings should be made with a shrinkage rule, which is so divided that each foot is equal in length to $12\frac{1}{8}$ standard inches. This insures that the casting will be of the proper size after it has cooled, as the shrinkage is usually about $\frac{1}{8}$ inch to every lineal foot.

149. Patterns for Castings.—The patterns, or models, used for making castings are generally of wood, but are also of plaster of Paris, or even of bronze or iron where a great many castings are to be made. For large work, wooden patterns are used. Patterns for fine work, such as ornamental moldings, capitals, etc., are modeled first in wax or clay, from which a casting is made in plaster of Paris. This casting is used in making the mold.

150. Shrinkage of Metals.—The shrinkage, in casting, of metals other than iron is as follows:

Metal	Inch Per Foot
Copper	$\frac{3}{16}$
Lead	$\frac{1}{8}$
Aluminum	$\frac{3}{16}$
Brass	$\frac{3}{16}$
Steel	$\frac{1}{4}$
Tin	$\frac{1}{12}$
Zinc	$\frac{3}{16}$

151. Cast-Iron Work.—Cast iron is used in this connection for window frames and mullions, sills, stairway newels, strings, balusters, panels, tracery, grille-work, etc.

152. Wrought-Iron Work.—Wrought iron is used for bank grilles, elevator enclosures, elevator cages, window guards, gates, fences, lamps, balcony railings, stair railings, ornamental wall anchors, chimney anchors, finials, ornamental strap hinges, etc.

An attractive surface for wrought-iron work where used for wall anchors, shields, torches, or the like, is obtained by allowing the natural hammer marks to remain.

153. Moldings in Ironwork.—Moldings in cast or wrought iron should not have too fine members or deep quirks, but should be rather plainly and coarsely molded.

154. Methods of Fastening Metal Work.—Square-head bolts, screw-head bolts, countersunk-head bolts, button-head bolts, tap bolts, lag-screws, and expansion bolts are used to fasten cast and wrought metal work.

Iron fences are fastened to stone copings or to stone posts in the ground by means of melted lead, cement, sulphur, or rosin. Lead, however, is best for this purpose.

155. Painting Ornamental Ironwork.—All ornamental ironwork should be painted with either red lead, iron oxide, or bituminous paint for a priming coat, according to its location, and should then be painted with lead and oil, bronzed or gilded, as the architect may desire. Wrought-iron work in interiors may be cleaned and shellacked so as to show the natural color of the metal.

156. Plating Ironwork.—Ornamental ironwork may be electro-copper plated and finished the same as bronze work. Plated work should never be used on the exterior of a building, or where it will be exposed to extreme dampness, as the iron will rust through the plating.

157. Bronze Work.—Architectural bronze is classified as cast bronze and wrought bronze. Cast bronze is an alloy composed of not less than 90 per cent. copper, nor more than 8 per cent. tin, the balance to be either lead or spelter. Wrought bronze is either rolled in sheets, or extruded, that is, run through steel dies, under pressure. Cast bronze is used for statues, memorial tablets, lamps, all ornamental work such as caps, etc., on bank screens, etc. Wrought bronze is used for plain panels and moldings on bank screens and bronze doors, and for bronze window frames, etc. Bronze tablets or other bronze work should be fastened to stonework or brickwork by means of expansion bolts, the heads of bolts being covered with bronze rosettes or buttons.

158. Finishing Bronze.—The finishing of bronze work is an important item as it means much in the appearance of the work. The simplest and cheapest finish for cast bronze is to remove the fire skin by filing or grinding, and allow the metal to retain its natural color. For fine decorative

work, especially in interiors, special finishes such as light statuary, dark statuary, verde antique, etc., may be given it by the use of various chemicals properly applied. Exposure to the weather always produces considerable change in the appearance of bronze. This is due to oxidation, and the coating thus formed, called a *patina*, protects the metal from further oxidation.

159. Phosphor bronze is a bronze containing a certain amount of phosphorus, which adds greatly to its hardness. It is suitable for foot-scraper blades, bearings, hinges, door-knockers, special bolts, etc.

160. Brass Work.—Brass is an alloy similar to bronze, except that it contains a greater proportion of tin, some brass being half tin and half copper. Wrought brass is applicable to most of the decorative purposes of wrought iron, though, of course, more expensive, but not as expensive as bronze. The bright polish which brass takes renders this metal valuable in some classes of decorative work such as interior grilles, railings, finished hardware, etc.

161. Polished brass as a trim for cast bronze makes an attractive combination. Turned and polished brass or bronze should not have very deep or sharp fillets or quirks, as they are difficult to get at with the buffer and must be polished by hand, thus adding much to the expense.

162. Gun metal is an alloy of copper and tin, and does not suffer on exposure to the weather.

Brass, bronze, or gun metal may be turned in the lathe.

163. Metal-Work Manufacturers.—The manufacturers of ornamental metal work in this country do very fine work both in wrought and cast metal, and the technical side of the work may well be left to them. Books containing illustrations of their best work are published by these manufacturers.

SHEET-METAL WORK

164. Metals Used for Sheet-Metal Work.—Sheet metals as now used comprise iron and steel, tin, copper, zinc, and lead.

165. Sheet iron and steel is made in sheets that are from $\frac{1}{80}$ to $\frac{9}{64}$ inch thick and weigh 8 to 90 ounces per square foot and are graded by the U. S. Standard gauge from No. 30 to No. 10 gauge. Galvanizing adds about $2\frac{1}{2}$ ounces per square foot and corrugating adds about 4 ounces. The best plates now on the market are rolled from ingot iron which is supposed to resist corrosion. Galvanized sheet iron is used for gutters, leaders, cornices, skylights, etc., and corrugated iron is used for roofing and siding warehouses, factories, store houses, and similar buildings. It should be painted with oxide of iron paint.

166. Sheet Copper Grading.—Sheet copper is graded by the weight per square foot. It is made from 4-ounce to 23-ounce in weight. The weights in general use for roofing, flashing, cornice work, etc., are 10 ounce, 12 ounce, 14 ounce, 16 ounce, and 20 ounce. For roofing, soft or roofing temper is used, and for gutters, leaders, cornices, etc., hard or cornice temper is used.

167. Sheet Zinc.—Zinc has been used very little for roofing, as it expands and contracts more than any other roofing metal, but it has been coming into use more of late years. Pure sheet zinc has the advantages that it is very durable, is generally cheaper than copper, and is absolutely stainless. The surface of zinc is protected in a manner similar to bronze, that is, a patina forms on its surface and prevents further oxidation.

Sheet zinc is made in sheets that weight from .37 lb. to 1.5 lb. per square foot, and are from .01 to .04 inch per square foot in thickness.

168. Sheet lead may be obtained in sheets that are from $\frac{1}{26}$ to $\frac{1}{5}$ inch thick and weigh from $2\frac{1}{2}$ to 12 pounds per foot. It is usually designated by weight per foot, and is used principally for counterflashing and roofing.

169. Hard lead which has recently been put on the market is a lead which has been made harder than the regular sheet lead. It is used for roofing, gutters, leaders, rainwater heads, etc. The manufacturers claim a higher tensile strength and five times the elastic limit of soft lead.

170. Tin plate is sheet steel or sheet iron coated with tin. It is seldom if ever used at the present time for roofing or other building purposes, its place having been taken by the terne plate.

171. Terne plate is sheet steel or sheet iron, generally steel, coated with a mixture of lead and tin in about the proportion of one of tin to two of lead. The best terne plates now on the market are made from copper-bearing steel which appears to resist corrosion better than plain steel. Terne plate is used principally for roofing, but it is also used for leaders, gutters, flashings, hot-air pipe, speaking tubes, etc.

172. Grades and Sizes of Tin and Terne Plates.—The different grades of tin plate are designated by the weight of 112 14″×20″ sheets, which is the usual number of sheets in a box. The most common grades are designated as IC and IX; the former weighs from 107 to 120 pounds and the latter from 135 to 150 pounds. Sheets 20 in.×28 in. are also made, which should weigh twice as much per box; the sheets are stamped IC or IX. The thickness of the coating adds to the durability of the tin plate, but the thickness of the plate does not. Terne plate weighs about the same as ordinary tin plate. Tin plate is also made in 14″×10″ sheets and other sizes, but these plates are not used so generally as the sizes just stated.

The sheet steel or iron on which the tin coating is placed should weigh from 95 to 100 pounds to the box for IC, 14″×20″ sheets, and 125 to

130 pounds for IX. The weight of the coating varies from 8 to 40 pounds to the box, and usually is stamped on the sheet.

In making a selection of roofing tin, the architect should investigate the methods of manufacture, so as to learn the quality and thickness of the plate and coating.

173. Flashings.—Flashings may be of tin, copper, sheet lead, or galvanized sheet iron. Sheet copper is the best material for flashings. All flashings should be counterflashed. Sheet lead makes the best counterflashing where tin flashing is used, as building in tin is liable to scrape off the coating. Tin or galvanized-iron flashings should never be counterflashed with copper, as the copper coming in contact with the tin plate will cause electrolytic action.

174. Gutters.—Gutters are either *hanging*, *box*, *roof*, or *parapet*.

Hanging gutters are always preferable where it is possible to use them. They can be made of tin, copper, or galvanized iron.

Roof or box gutters may be of tin, copper, or zinc, and should be large in size and have ample pitch. The pitch of gutters should not be less than 1 inch in 10 feet.

All gutters except those made of copper or zinc should be painted on both sides.

Wire baskets, which are used to protect down-spout openings in gutters, should be made of copper wire when the gutters are copper. When the gutters are galvanized iron, the baskets should be galvanized iron, to avoid electrolytic action.

175. Gutters and Valleys.—Gutters, valleys, etc., where under more or less wear, should be of the heavier coated tin or copper. Down spouts should be of galvanized iron or copper. (Tinned-iron nails should be used to fasten tin.)

176. Hangers for Gutters.—Stock hangers are made by which hanging gutters are fastened in place. For tin or galvanized-iron gutters, galvanized hangers should be used, but for copper gutters brass hangers should always be used.

177. Leaders.—Galvanized-iron or copper leaders corrugated or rectangular in shape should be used, and they should have 1 square inch in section for each 100 to 150 square feet of roof area drained. No leader with an area less than that of a 2-inch round pipe should be used.

Leaders are usually fastened by expansion bolts or patent hangers. Sometimes, however, decorative straps in connection with expansion bolts or screws are used to support leaders; but more frequently these straps simply cover the hanger or other means of support.

178. Rainwater heads are used at the tops of leaders and cover up the bends that issue from cornices. The tops of these heads should be

covered so as to prevent birds from building nests in them. Stock designs are carried by some dealers, but, as a rule, special designs are more acceptable. They are made of the same metal as the gutters to which they are attached.

179. Leader-Pipe Bases.—For leader pipes, cast-iron bases that are very neat in pattern are now manufactured. Leaders are cemented into these bases. This makes a much better appearance than where the cast-iron pipes are extended above grade with the leaders cemented into them. These cast-iron bases are calked into the hubs of the cast-iron sewer pipes below.

180. Cornices.—Metal cornices are made of copper and galvanized iron, and are fastened to the building by wooden or iron lookouts. Copper is the best material to use. If galvanized iron is used, it should be thoroughly painted on both sides. Iron lookouts used for this work should have two good coats of red lead or iron-oxide paint. Copper cornices do not require painting, as the patina that forms on the copper is sufficient protection.

Copper and galvanized-iron cornices are often formed with a milled or imitation tooled surface, which, after being painted, is sprinkled evenly with white sand while the paint is still wet. When dry, this makes a fair imitation of stonework.

181. Solder spots on a copper cornice should be copperplated in order that they may not show on the surface after the patina has formed, or else all joints should be riveted with copper rivets.

182. Other Sheet-Metal Products.—Imitation tile, siding, brick, etc., are now made in copper, tin, and galvanized iron. Work of this kind in tin and galvanized iron should be thoroughly painted on both sides before laying.

Coping coverings, chimney caps, balustrades, outside light standards, candelabra, flagpole bases, etc., are made of copper and galvanized iron.

FIREPROOF WINDOWS

183. Fireproof windows are required in most cities on exposed walls on party lines, in the rear of buildings and on alleys. The use of fireproof windows also reduces the insurance rates in many cases where they are not required by building codes.

184. Hollow Metal Windows.—The type of window most generally used is the hollow metal window, which is constructed so as to give a series of hollow air chambers in the frame and sash. These windows are generally constructed of No. 24 gauge galvanized sheet steel, but for expensive work may be made up of sheet copper. They are made double

hung and pivoted. In designing buildings with hollow metal windows, care should always be taken to see that the size of the window or the size of the individual lights of glass does not exceed the maximum sizes allowed by the National Board of Fire Underwriters. Single double-hung windows can not exceed 6 feet in width by 10 feet in height, and single-pivoted windows 5 feet in width by 10 feet in height. Windows must always be glazed with wire glass and the maximum size allowed for each light of glass must not exceed 720 square inches, and in no case shall it exceed 54 inches in height nor 54 inches in width.

185. Rolled-Steel Windows.—A very good type of window for factory and warehouse construction is made up from rolled steel shapes, which are joined together by an interlocking dovetailed joint. These windows are made up in standard sizes and have the advantage of strength and lightness, are easily handled and set, and are weather-tight and fire-resisting. The sash are always stationary, but they are frequently fitted with pivoted ventilators. Rolled-steel casement sash and frames are made for fine residential work and make an excellent weather-tight window.

FIREPROOF DOORS AND TRIM

186. Hollow Metal Doors and Trim.—For interiors where a fine finish is desired hollow metal doors with drawn steel trim are used. This work is made up from cold-rolled steel furniture stock, and is put together so that all construction is concealed. All joints are electrically spot-welded, moldings being coped together. The work is finished by giving it four or five coats of enamel, each coat being baked on separately, while the final finish is grained in imitation of natural wood. This construction is largely used for elevator doors and doors around fireproof stair towers, etc.

187. Kalamein Doors and Trim.—A cheaper type of fireproof construction for fireproof doors, trim, etc., is Kalameined iron, which is a process of drawing sheet steel or iron tightly over a wood core. This work may be painted or grained to imitate natural wood.

188. Tin-covered doors and shutters are built with wood cores made up of white pine or similar non-resinous wood, made in three thicknesses of $\frac{13}{16}$-inch tongued and grooved boards. The outside layers should be vertical and the inner layer horizontal and securely fastened together with wrought-iron clinch nails. Doors should be covered on both sides and all edges with I.C. terne plate put on with lock joints nailed under the seams. These doors are made either sliding or swinging and are hung on special hardware.

CARPENTRY

MATERIALS

189. Uses of Lumber and Timber.—The various kinds of lumber and timber are generally used for the following purposes:

Framing: Hemlock, spruce, white pine, yellow pine, Douglas fir, oak, and redwood.

Sheathing: Hemlock, spruce, tamarack, white pine, yellow pine, and redwood.

Shingles: Cedar, cypress, redwood, and white pine.

Siding and other exterior trim: White pine, yellow pine, cypress, poplar or white wood, redwood, Douglas fir, and Sitka spruce.

Interior finish: White pine, yellow pine, poplar, gum, birch, white and red oak, maple, chestnut, walnut, mahogany, ash, Douglas fir, redwood, etc.

Piles: Elm, beech, oak, yellow pine, locust, Douglas fir, cedar, and chestnut.

Fence posts: Chestnut, locust, cypress, redwood, and cedar.

Half timber: Red oak, chestnut, yellow pine, cypress, and white pine.

190. Stock Sizes of Lumber.—The following is a list of the different kinds of lumber in general use and the sizes commonly kept in stock by lumber dealers. Other woods in thicknesses and lengths governed by the size of their growth, may be obtained by special order. This list is given only as a general guide and may include more or less than will be found in some localities:

Hemlock framing lumber: $2''\times3''$, $2''\times4''$, $2''\times6''$, $2''\times8''$, $2''\times10''$, $2''\times12''$, $3''\times4''$, $3''\times6''$, $3''\times8''$, $3''\times10''$, $3''\times12''$, $4''\times4''$, $4''\times6''$, $4''\times8''$, $6''\times6''$, $6''\times8''$, $8''\times8''$. This timber may be obtained in even lengths of from 12 feet to 28 feet.

Spruce framing lumber: $2''\times4''$, $2''\times6''$, $2''\times8''$, $2''\times10''$, $2''\times12''$, $3''\times4''$, $3''\times6''$, $3''\times8''$, $3''\times10''$, $3''\times12''$, $4''\times4''$, $4''\times6''$, $4''\times8''$, $6''\times6''$, $6''\times8''$, $8''\times8''$.

Yellow pine framing lumber: $2''\times4''$, $2''\times6''$, $2''\times8''$, $2''\times10''$, $2''\times12''$, $2\frac{1}{2}''\times6''$, $2\frac{1}{2}''\times8''$, $2\frac{1}{2}''\times10''$, $2\frac{1}{2}''\times12''$, $3''\times6''$, $3''\times8''$, $3''\times10''$, $3''\times12''$, $4''\times4''$, $4''\times6''$, $4''\times8''$, $4''\times10''$, $4''\times12''$, $6''\times6''$, $6''\times8''$, $6''\times10''$, $6''\times12''$, $8''\times8''$, $8''\times10''$, $8''\times12''$, $10''\times10''$, $10''\times12''$ $12''\times12''$, in even lengths of from 12 feet to 28 feet.

It should be remembered that the actual sizes of framing timbers is from $\frac{1}{4}''$ to $\frac{1}{2}''$ less than the sizes given here, especially if the timbers are surfaced.

Matched yellow pine flooring: $\frac{13}{16}''\times2\frac{3}{8}''$, $\frac{13}{16}''\times3\frac{1}{4}''$, $\frac{13}{16}''\times5\frac{1}{4}''$. The widths given are for face and do not include tongue.

Matched oak flooring: $\frac{3}{8}''\times1\frac{1}{2}''$, $\frac{3}{8}''\times2''$, $\frac{13}{16}''\times1\frac{1}{2}''$, $\frac{13}{16}''\times2''$, $\frac{13}{16}''\times2\frac{1}{4}''$. The widths given are for face and do not include tongue.

Matched maple, birch, and beech flooring: $\frac{13}{16}''\times1\frac{1}{2}''$, $\frac{13}{16}''\times2\frac{1}{4}''$, $\frac{13}{16}''\times3\frac{1}{4}''$. The widths given are for face and do not include tongue.

Matched yellow pine ceiling: $\frac{5}{16}''\times3\frac{1}{4}''$, $\frac{7}{16}''\times3\frac{1}{4}''$, $\frac{9}{16}''\times3\frac{1}{4}''$, $\frac{13}{16}''\times3\frac{1}{4}''$. All widths are for face and do not include tongue.

Matched rough hemlock flooring: $\frac{7}{8}''\times5\frac{1}{2}''$.

Matched rough spruce flooring: $\frac{7}{8}''\times3\frac{1}{2}''$.

Finishing lumber. Yellow pine: $\frac{4}{4}''$, $\frac{5}{4}''$, $\frac{6}{4}''$, and $\frac{8}{4}''\times4$, 6, 8, and 12″. White pine, cypress, plain oak, quartered oak, yellow poplar, tupelo, etc., $\frac{4}{4}''$, $\frac{5}{4}''$, $\frac{6}{4}''$, $\frac{8}{4}''$, in random widths up to 18 inches in some cases.

The lengths of the foregoing material run from 10 to 20 feet.

Mahogany is used almost invariably as a veneer, and as it is cut from the circumference of the log, it may be obtained in almost any width that can be handled, and up to any practical length for working. It can also be obtained up to 2 inches in thickness and in random widths for cutting where solid stock has to be used, such as moldings, spindles, etc.

White pine siding: $\frac{7}{16}''\times\frac{3}{16}''\times3\frac{1}{2}''$, and $\frac{7}{16}''\times\frac{3}{16}''\times5\frac{1}{2}''$.

Shingles: Cedar, 16″, 18″ and 24″ long; redwood, 16″ and 18″ long; white pine, 16″ and 18″ long; yellow pine, 16″ and 18″ long; cypress, 16″, 18″ and 24″ long. Widths vary from 4″ to 8″.

191. Lumber Defects.—The various defects in lumber are knots, knot holes, splits, shakes, wane, red heart, pith, rot, rotten streaks, worm holes, pitch, streaks, pitch pockets, torn grain, loosened grain, seasoning or kiln checks, and sap stains. As a certain percentage of these defects are now allowed in all grading rules and a number of them do not affect the strength nor the durability of the lumber, it is not wise to exclude them, except in finishing lumber to be used in the highest grade of work where selected material should be called for and all defects excluded.

192. Dry Rot.—The disease of timber known as *dry rot* is difficult to eradicate, but is prevented by sunlight and circulation of air. For this reason, framing timbers should always have their ends free, as is provided by the use of standard hangers. To eradicate dry rot, cut away and burn off all affected parts and coat all sound timber left with boiling tar or a cold solution of corrosive sublimate, and also provide for a good circulation of air about the timber.

193. Wet Rot.—Wet rot is avoided by keeping timber dry or else continually wet. If neither of these conditions can be had, impregnate the wood thoroughly with creosote, which will also keep the teredo (a wood worm) from attacking the wood when placed in salt water.

194. Wood Characteristics.—Woods with different characteristics are as follows:

Elasticity: Ash, and chestnut.

Elasticity and toughness: Oak, beech, elm, and walnut.

Durability, when kept dry: Cedar, oak, poplar, yellow pine, and chestnut.

Durability, when kept wet: Elm, beech, sycamore, white cedar, and teak.

Suitable for carving: Pear wood, white pine, mahogany, box, and poplar.

195. Growth and Cutting.—Ordinarily, the architect is not concerned with the growth of timber, but should be with the condition of timber as delivered at the building. Therefore, a knowledge of the methods of cutting and seasoning is necessary, so that a better conclusion as to the quality of timber delivered for inspection may be reached.

196. Forest-Grown Timber.—Forest timber is better than that grown in open spaces, and timber grown in dry ground is better than that grown in wet ground.

197. Bled Timber.—It is claimed, as the result of tests, that bled long-leaved pine is just as strong as that which has not been bled. Some authorities hold that bled timber is brittle and liable to dry rot.

198. Air and Water Seasoning.—To air-season timber requires anywhere from 2 to 4 years. Water seasoning, which is simply a method of dissolving the sap from the wood by soaking in running water for about 2 weeks, instead of getting rid of the sap by evaporation, as by the other methods, demands air or kiln drying afterwards to free it from moisture and remaining sap.

199. Air- and Kiln-Dried Trim.—Interior and exterior trim should be both air- and kiln-dried, and when possible should be stacked in the building for some time before being put in place, in order that it may adapt itself to the atmosphere of the building.

200. Effects of Exposure.—Exposure to air and moisture, which is prevented by varnishes and paints, has the following effects on different kinds of woods:

Mahogany, Baltic fir, Norway fir, white pine, and chestnut become darker on exposure.

Oak, baywood, and walnut are bleached by sunlight.

Elm, teak, and greenheart are hardened by immersion in water.

Oak and firs are softened by immersion in water.

Pines and mahogany are rapidly destroyed by immersion in water.

Oak, spruce, chestnut, and larch become hard on exposure to the air.

Baltic fir, baywood, redwood, and certain species of mahogany become brittle on exposure to air.

201. Shrinkage of Timber.—The shrinkage of timber is an important factor in building construction and should always be considered in the

framing of a building. It is greatest transversely to the grain and should be avoided or equalized as much as possible as it is the principal cause of cracks in plaster, the binding of doors and windows and other troubles of a similar nature. The amount of shrinkage in ordinary soft woods is about 3 or 4 per cent. of its width and thickness.

202. Specifying Lumber and Timber.—In the specifying of lumber and timber it is necessary to specify by name the various kinds of lumber and timber which are to be used, and the different grades required. Grades should always be specified according to the standard grading rules of the various lumber associations. These grading rules may be obtained from almost any progressive lumber dealer or mill man or directly from the associations.

203. Timber Pine.—Southern pine includes the species of yellow pine growing in the Southern states from Virginia to Texas. These are known as Cuban pine, long-leaf pine, loblolly pine, pond pine, and short-leaf pine. Cuban pine is generally the strongest and hardest and contains the greatest amount of pitch; long-leaf pine comes second, loblolly pine third, pond pine forth, and short-leaf pine last. For purposes of better classification, the American Society for Testing Materials has divided Southern pine timber into two classes designated as: (*A*) dense Southern yellow pine; and (*B*) sound Southern yellow pine. These terms are descriptive of quality rather than of botanical species. Air-dried yellow pine is about 50 per cent. stronger than green timber and kiln dried is about 30 per cent. stronger than air dried.

STRUCTURAL FRAMING

204. Floor joists should be butted where possible, and not lapped, and cleats should be nailed to each side lapping both joists and thus tying them together. Every fifth joist in buildings having brick walls should be provided with a wrought-iron T anchor spiked to the end of the joist and extending into the brick walls.

Anchor joists should be tied across the building by means of wrought-iron straps spiked to the ends of each joist. Non-bearing walls should be tied to floor joists by side-wall anchors which should extend across three joists and be spiked to each joist. Floor joists and tie joists should be crowned slightly at the center to allow for sagging when the weight of the floor, etc., is placed on them.

205. Floor Bridging.—The upper ends of the bridging should be nailed to the joists as soon as the joists are leveled. The lower ends are nailed as soon as the rough floor is laid.

206. Utility of Partition Bridging.—Bridging between the studding makes good fire-stops and stiffens the partitions. This bridging should be placed at an angle of 45°, the adjacent ends of bridging being on the

same level. This makes a stiff job and gives a better chance for the plaster key than horizontal bridging.

207. Studding and Joists.—The lengths of studding and joists should conform as nearly as possible to the stock lengths of timber. This means a considerable saving in a large building, as there is less cutting to do and less waste of material.

The cutting of joists to fit over the wall plate is customary, but it is better to rest the joist directly upon the plate, as this gives the strength of the full depth of the beam. The objection to this is that it requires a great length of studding for the same height of story and consequently adds to the cost of the building. The space between the joists from wall to under side of floor is often filled with brick to form a fire-stop. The brick should be kept not less than 1 inch below the floor to allow for shrinkage of joists.

Studding and joists are spaced 12 or 16 inches on centers in order to obtain even nailing for lath that are 4 feet long. This point should be kept in mind in making framing plans.

208. Chimney Angles.—Where chimneys are reduced in width at any floor, the flues are often too close for safety to the trimmer joists, at the angle where the chimney is reduced in size, and the flue is on a pitch. This should be watched, and avoided by throwing the flue over at a lower level or keeping the joists well away from the angle.

209. Hearth Arches.—Where hearth arches are employed to support large fireplace hearths, iron rods may be built into the chimney and allowed to pierce the header against which the arch abuts, being fitted on the opposite side with bolts and washers. This will prevent the header from giving any, by reason of the thrust of the arch.

210. Grounds for trim, wainscots, etc., should have beveled edges to form a key for plaster, and should be about $\frac{1}{4}$ inch narrower than the trim which is to be nailed to it in order that the finished work may not have too great a lap on the plaster. Where joists or studding are more than 2 inches thick, and it is possible to do so, $1'' \times 2''$ cleats or cross-furring should be nailed to them to receive the lath, as the greater width of the joists and studding cuts off considerable of the keys of the plaster in the length of a lath.

211. Window Framing.—When framing for windows, the carpenter adds from 10 to 12 inches to the width of the glass to get the rough framed opening if it is double hung, and 8 to 10 inches if a casement. The size of glass is given on the elevations, and the carpenter makes calculations from these dimensions, adding to them the specified widths of the sash, muntins, pulley stiles, boxes, and back casings, if any. The additional height is figured in the same way, and is from 10 to 12 inches.

212. Door sizes to the finished jamb are given on drawings, and in framing a total allowance of about 5 inches in width and about 3 inches in height is made for false jambs and head. The carpenter should block well behind the false jambs, especially opposite the hinges. This is very important in connection with double-acting doors. The allowances spoken of here and in Art. **211** are obtained from the full-size details.

213. Sheathing.—The sheathing should be put on diagonally, as it stiffens the entire building more than horizontal sheathing.

EXTERIOR WOODWORK

214. Built-up columns are made exclusively by several manufacturers, and as their facilities are much better for this work than those of the average mill, their product should be used where possible. Built-up columns should be primed before leaving the mill.

215. Porch Posts.—Plain porch posts are often set on iron shoes that raise the base a couple of inches from the floor, thus protecting it from moisture. All porch columns, posts, etc., should have their end wood thoroughly soaked with white lead.

216. Porch Pedestals.—Where pedestals are placed on either side of porch steps, they should be of brick or stone if permissible. If made of wood, they should be supported on masonry foundations and the wood kept as far from the ground as possible.

217. Porch Floors.—Fir, white pine, and cypress are used for porch floors and the like. The grooves should be generously painted with white lead and the tongues well driven into place. Straight-grained lumber is best for outside floors, and all flooring should be thoroughly seasoned.

The flooring of porches should run outwards from the building or in the direction of the pitch; the ceiling should also run in the same direction. The pitch of the floor should be about $\frac{1}{8}$ inch to the foot. No end wood should be allowed, as it is very absorbent and usually rough.

The butt joints at angles of porches should be joined by a metal spline. Heavy strap iron is frequently used.

218. Porch Steps.—Wooden steps for porches, etc., sometimes have treads formed of strips with $\frac{3}{8}$- or $\frac{1}{4}$-inch spaces between them, for drainage; or if made of one piece, each tread should have a suitable number of $\frac{1}{2}$-inch holes bored for the same purpose.

219. Gate and clothes-line posts should have bases formed of two pieces of timber at right angles to the post with braces from post to base. All this work below ground should be thoroughly tarred or creosoted.

220. Door and Window Frames.—Door frames for outside doors should be from $1\frac{3}{4}''$ to $2\frac{1}{2}''$ thick rabbetted, and where stone sills are not

provided they should have rabbetted sills 2″ to 2¼″ thick, preferably of white or red oak. Where stone sills are provided, frames should have iron dowels connecting the frame to stone sill. Frames in brick or stone walls should have 2″×4″ wind stops nailed to the back of jambs and should be anchored into the masonry by means of wrought-iron joggles. Casement window frames should be constructed the same as door frames. Box frames should be properly framed together and should have $\frac{9}{16}$″ wood or galvanized sheet-iron pendulums hung from yokes, between the weights.

221. Stock Windows.—Windows ready for use are made either with check rails or plain rails, grooved for cords or plain, as in many cases the windows in cheap work are hung without weights.

The usual stock sizes in common use are as follows:

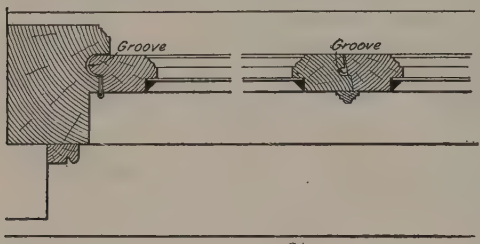
Two lights,	18″×20″	$1\frac{3}{8}$ inches thick check rail or plain rail
Two lights,	20″×20″	
Two lights,	18″×24″	
Two lights,	20″×24″	
Two lights,	24″×24″	
Two lights,	18″×28″	
Two lights,	20″×28″	
Two lights,	24″×28″	
Four lights,	12″×20″	$1\frac{1}{8}$ inches thick check rail or plain rail
Four lights,	12″×24″	
Four lights,	12″×28″	
Four lights,	14″×20″	
Four lights,	14″×24″	
Four lights,	14″×28″	
Eight lights,	8″×10″	$1\frac{1}{8}$ inches and $1\frac{3}{8}$ inch thick check rail or plain rail
Eight lights,	8″×12″	
Eight lights,	8″×16″	
Eight lights,	10″×12″	
Eight lights,	10″×16″	
Eight lights,	12″×14″	
Eight lights,	12″×16″	
Twelve lights,	8″×10″	$1\frac{1}{8}$ inches and $1\frac{3}{8}$ inch thick check rail or plain rail
Twelve lights,	8″×12″	
Twelve lights,	10″×12″	
Twelve lights,	10″×16″	
Twelve lights,	8″×10″	$1\frac{3}{8}$ inches thick check rail or plain rail
Sixteen lights,	8″×10″	
Twenty lights,	8″×10″	

222. Weight of Sash.—In hanging sash the weights for the upper sash should be at least ½ pound heavier than the sash itself, in order that the sash may be kept tight up against the head. The weights for the lower

sash should be about ½ pound lighter in weight than the sash, so that the lower sash will stay down. A number of types of spring sash-balances are made which do away with the weights, but none of them are entirely reliable.

223. Metal splines sunk into wood and stone sills and well set in asphalt or other cement, keep water from working back under the sill. See Fig. 1 (*a*).

224. Devices for Large Windows.—For very large windows where the meeting rails are too high to reach, a catch should be placed on the stile of the lower sash with a strike plate let into the pulley stile. Such sash should also have a countersunk metal socket in the top rail of the upper sash, in order that it may be lowered by means of a wooden rod with a metal hook that fits into the socket.



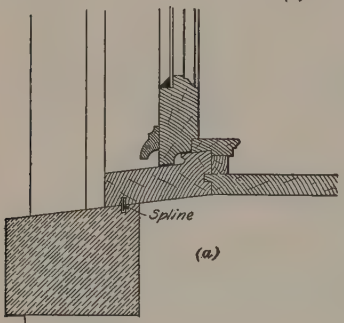


FIG. 1

225. Capillary Attraction.—The tendency of water to work itself between two closely adjacent surfaces, against the force of gravity, known as *capillary attraction*, should be guarded against in window-sash design. The lower rail of the lower sash in particular should be taken care of by throating, and the sill should be well pitched and rabbeted for the sash [see Fig. 1 (*a*)]. Where French casements are used, the meeting rails should be beveled, rabbeted, and grooved, and the hanging stiles tongued into jambs [see Fig. 1 (b)]. The grooves in the jambs and meeting rails should be sufficiently large to allow the water that may work into them to run away.

226. Position of Casements.—The washing of a window should always be considered in connection with its position, and casements should be made to swing inwards if possible (although such windows are harder to make storm-tight), as they are easier to wash. A casement on the second floor that swings outwards is almost impossible to wash on the outside, greatly to the annoyance of the housewife.

227. Skylights should be protected with wire where there is danger of breakage from falling objects, as at the base of light wells. Where the

skylight is not double, provision should be taken to carry away the water of condensation that forms on the under side of the glass. This is done by grooving the sash bars, or muntins, or placing small metal troughs under them. These grooves, or troughs, are led to the lowest point of the skylight and discharged through the curb to the roof.

228. Painting and Puttying.—Putty for skylights should contain a non-drying oil that will keep the putty elastic and prevent cracks. Window sash should be painted before puttying. If they are not painted, the wood will absorb the oil from the putty and render it brittle.

Where very heavy sheets of glass are used, they should be *back-puttied*, that is, putty should be placed on the rabbet so as to form a bed on which the glass may rest.

229. Painting Backs of Trim.—The back of all inside trim, the under side of stairways, seats, trim, etc., should be painted before being put in place, to protect against dampness, dry rot, etc.

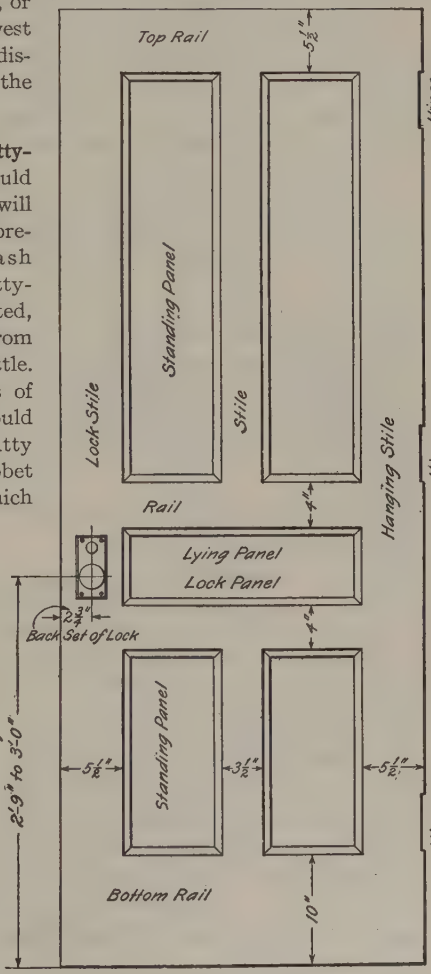


FIG. 2

INTERIOR WOODWORK

230. Stock Doors. Four-panel and five-panel doors are kept in stock by dealers and may be obtained in 2′ 0″, 2′4″, 2′ 6″, 2′ 8″, and 2′ 10″ widths, and in 6′ 0″, 6′ 6″, 6′ 8″, 6′ 10″, and 7′ 0″ heights; thicknesses being $1\frac{1}{8}$″ and $1\frac{3}{8}$″ for 2′ 0″ and 2′ 4″ doors and $1\frac{1}{8}$″, $1\frac{3}{8}$″ and $1\frac{3}{4}$″ for doors 2′ 6″ and wider. They are made up of white pine, yellow pine, poplar, fir, and cypress. Several manufacturers are making

doors veneered with birch, oak, and gum, both paneled and flush-veneered, which are also kept in stock.

231. Door Paneling.—The paneling of a door should be so arranged that the lock will not cut into the tenon of a rail. In Fig. 2, the names of the different parts of a door are given, with the common dimensions of stiles and rails. The hinges should line up with the paneling as indicated.

232. Door Cores.—The cores of veneered doors are usually made of white pine, ash, or chestnut, as these woods take glue well.

233. Painting Door Panels.—Panels of doors that are to be painted or stained should be treated before being incorporated in the door, so that any shrinkage that may occur will not expose the unstained or unpainted wood, which would be the case if the painting or staining were done after the door is made.

234. Proper Swing for Doors.—Doors leading to pantries, lavatories, bathrooms, and bedrooms should swing in such a way that the greater part of the room will be hidden until the door is wide open. Closet doors should open in a direction that will give the most light to the closet from windows and lighting fixtures. Outside doors to public buildings should open outwards.

235. Sliding doors are hung on tracks and hangers, of which there are a number of makes on the market.

236. Double-acting doors are pivoted top and bottom, and various types of spring hinges are made for this purpose. The back of the hanging stile should be rounded so that it may be swung close to the jamb and still have clearance. The pivot that is let into the bottom rail of the door is preferable to the type that is sunk in the floor, the latter being liable to become filled with dust or dirt.

237. Door Hanging.—A good appearance is obtained by projecting the face of a door $\frac{1}{8}$ inch beyond the edge of the jamb lining; this covers the joint between the jamb and architrave and gives the hinges more clearance.

238. Entrance Side Lights.—The lights placed at the sides of entrance doors should not be wider than 8 inches if of leaded glass, as they would afford easy access to a burglar. Other large leaded-glass lights in accessible positions should be avoided for the same reason.

239. Veneering.—In high-grade interior work, where hardwoods such as mahogany, walnut, etc., are used, work should always be veneered, especially panels, which are more liable to warp than are stiles and rails. Small panels may be veneered in three plies, but large panels should always be a five-ply laminated construction. Veneering should be done on white pine or chestnut cores of the proper thickness, then veneered both sides

with $\frac{1}{8}$ inch white wood and cross-veneered with the finished wood. To prevent warping the backs of the panels should always be veneered with the same wood as the faces. Face veneers of mahogany are sometimes cut as thin as twenty-eight to an inch, but most cabinetmakers prefer to cut them a little thicker, as very thin stock is hard to handle successfully.

240. Fine- and Coarse-Grained Woods.—Woods of fine grain, such as black walnut, white pine, mahogany, and poplar, may be finely molded and are suitable for carving.

Woods of coarse grain, such as oak, chestnut, ash, and cypress, should be coarsely molded.

241. Curved Material.—Curved moldings for interior work should be carved or run in a machine and not kerfed. Curved panels and plain surfaces should be bent veneer on a built-up white-pine core.

242. Contour of Moldings.—If the architect wishes the contractor to follow the contours of the moldings exactly as shown on the full-size details, it should be emphasized by distinctly stating that no moldings that are not exactly according to details will be accepted, as the contractor is liable to change the contours somewhat at times in order to save undercuts (see Fig. 3), or a second running through the machine.

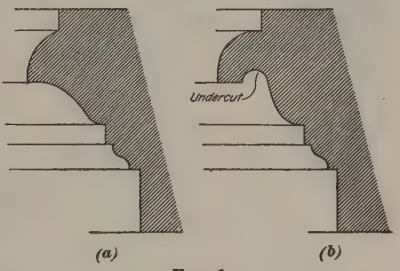


FIG. 3

243. Undercut Moldings. In designing paneling, etc., it should be remembered that undercut moldings cannot be scribed but must be mitered.

Undercut moldings are more expensive than moldings that can be cut in one run of the machine. In Fig. 3 (*a*) is shown a molding that can be run in one position with one knife and at (*b*) is shown the same molding so drawn that it will require two runs and knives.

244. Curved and Straight Moldings.—Where a curved molding meets a straight one in panel or other work, it should be stated whether the miter is to be straight or curved. If the straight miter is used, two different molding sections must be used, as shown in Fig. 4.

245. Wainscot Paneling and Casings.—The layout of wainscot paneling should not be left to the carpenter, but each side of the room should be laid out by the architect.

Casing plinth blocks are used to stop moldings of casings above the floor level where they are less liable to be broken or chipped.

Mitered casing if small should be tongued and grooved; larger ones should be splined.

246. Wainscoting.—Where wainscoting butts against the back band of a door or window casing, it should be tongued into it. This allows the wainscoting to shrink away from the trim slightly without opening the joint. It is a good rule in laying out wainscoting to keep the individual pieces reasonably small and to have the least dimensions transverse to the grain, with the purpose of lessening as much as possible the results of the inevitable shrinkage of the material.

247. Door Stops.—The stops of doors are usually simply planted on jambs. A better job, however, is obtained by housing them into the jambs.

248. Window stops should be fastened in place by stop adjusters, which are metal sockets countersunk into holes bored in the stop. Through these holes screws are driven into the window frame. The sockets are grooved at the bottom, and thus allow the adjustment of the stop in case the sash binds or becomes too loose.

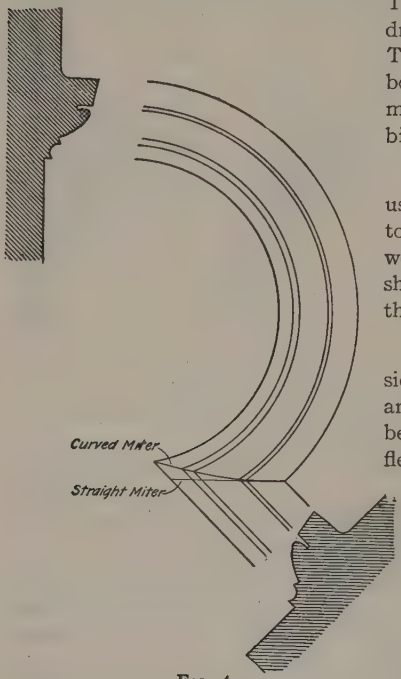


FIG. 4

249. Moldings.—The moldings used to fasten mirrors in place or to cover joints between tilework and woodwork of the fireplace opening should be screwed in place, so that they can be easily removed.

250. Glazing Rabbets.—The sides and backs of glazing rabbets and stops for mirrors, etc., should be painted black, to prevent reflection from the edges of the glass; and for lights of large size the backs of the stops should have felt glued to the surface of the wood to form a cushion for the glass.

251. Provisions for Curtain Rods, Rollers, Etc.—In detailing window trim, etc., sufficient plain surface should be left on which to fasten curtain rods, rollers, etc.

252. Wooden Dowels.—In the best cabinetwork, wooden dowels and glue are used as much as possible to the exclusion of nails and screws.

253. Built-in Wooden Seats.—Cushioned seats should be pitched back slightly, and an upset, which will serve to keep the cushion in place,

should be put on the nosing. The height of the seats from the floor should be from 16 to 19 inches if the seats are without cushions, and about 2 inches less if cushions are used.

254. Billiard-room seats should be up one or two steps, so that persons seated upon them may have a good view of the table top.

255. Seat tops are often fitted with hinged panels and the interior of the seat used for various purposes. If plaster is exposed inside of the seat, it should be lined with narrow $\frac{5}{8}$-inch ceiling.

256. Bases.—In public buildings, the base should not be of wood, but of marble, slate, terrazzo, or some non-absorbent materials.

257. Treads in Stairways.—The maximum number of treads in any flight of stairs should be twelve, where possible, and the minimum, three.

258. Risers and Treads.—The riser and tread of a stairway should always bear a certain relation to each other and one of the best rules, is that the sum of the rise and tread should equal $17\frac{1}{2}''$; $7''\times10\frac{1}{2}''$ or $7\frac{1}{2}''\times10''$, makes a very easy staircase. These dimensions do not include the nosing of the tread. Where the riser is $7\frac{1}{2}$ inches high, not less than 13 risers are required for head room.

259. Winders.—Winders, should not be used if it is possible to avoid them; but if they are used, there should be an odd number in order that an angle that will be difficult to clean may not be formed in the corner.

260. Hand Rails and Balusters.—The height of hand rails should be from 2′ 6″ to 3′ 0″ from the top of tread, to top of hand rail measured on the center of tread. At platforms and on floor levels the rail should be 2′ 10″ or more in height. Balusters should be dovetailed into treads and should be spaced the same on landings as on steps.

261. Bank Counters.—The counters used in banks for counting money or at tellers' windows should be covered with plate glass or marble. The proper height for the working counter is about 41 inches. The shelves at the windows are sometimes placed a few inches higher.

262. Kitchen Fixtures.—Kitchen work tables and sinks are usually 2 feet 8 inches from the floor. The drip board of the sink is most convenient on the right-hand side.

263. Refrigerators.—Outside ice doors for refrigerators are used and are a great convenience. They allow of keeping of the refrigerator inside and prevent the iceman from coming into the house. Refrigerators of standard makes are supplied with these doors, and their size and height from the floor, together with other particulars, may be obtained from the manufacturers. The jambs and casing of these doors should be protected with sheet zinc or copper.

264. Bookcase Shelves.—The shelves for bookcases are from 10 to 12 inches deep and should have one coat of varnish. They should be made adjustable by ratchets and cleats or by strips with holes and pins. The average number of books allowed for each square foot of shelving is nine.

265. Bookcase and Pantry Doors.—The doors of bookcases are glazed with plate or leaded glass, and they either slide or are hinged. The hinged doors are preferable, as sliding doors are very difficult to wash on the inside.

For pantry cupboards, sliding doors are not so objectionable, as the contents of the cupboard are usually much easier to remove than books. The space in pantries is limited also, and the swinging doors take up considerable room when open.

266. Bins.—Bins for sugar, flour, and salt are usually placed under the counter shelf of the pantry cupboard. They should be provided with vermin-tight covers.

267. Kitchen Closets.—Closets for brooms, dust pans, table leaves, and scuttles should be provided for the housekeeper.

268. Window Blinds.—Outside blinds should be hung by butts, with sufficient swing to clear the brick or stone jambs or wooden trim, as the case may be. Inside blinds are used in the folding and sliding forms.

The first type fold into pockets in the jambs and the second type are counterweighted and slide in guides at the jambs into pockets below the sills.

269. Rolling partitions, made of interlocking wooden strips, are manufactured and are much used for the subdivision of Sunday schools and other schoolrooms. They roll either into horizontal or vertical pockets, and are somewhat similar to the rolling shutters of roll-top desks.

270. Double Floors.—Where double floors are used, the baseboard should run to the rough floor and the finished floor should butt against this baseboard; this allows for shrinkage of the base and prevents an open joint at the floor due thereto.

271. Single Floors.—Where single floors with carpets are used, the shoe, or lower member of the base, should be kept $\frac{3}{16}$ inch off the floor in order to allow carpet to slip under. Where floors are to be varnished or waxed and no carpets used, the base should be well seasoned and, if possible, a grooved border with base tongued into it run about the room. If this cannot be done, the base should fit the floor as snugly as possible.

272. Finished Floors.—Oak, yellow pine, and maple are the principal woods used for finished flooring, while birch, and tupelo (bay poplar) are also used to some extent. All fine hardwood flooring and parquetry floors should be laid over a rough flooring laid diagonally. A layer of building paper or felt should be laid over the rough floor before laying

finished floors. Where carpets are not be to used, floors should be scraped, planed, and finished either by varnishing or waxing.

273. Parquetry is a mosaic of woodwork, used for floors, and is composed of small pieces tongued and grooved or splined together. Usually, the parquetry is $\frac{3}{8}$ inch to $\frac{7}{8}$ inch in thickness. It also sometimes consists of a veneer glued to canvas. It is shipped by the manufacturer in small sections, which are placed together by the carpenter.

274. Space for Door Mats.—A mat space sunk in the vestibule floor is often used in city residences. It keeps the door mat in its proper position and should be deep enough to bring the surface of the mat on a level with the floor.

ROOFING

275. Pitches for Different Roofing Materials.—The proper pitches for different roofing materials is shown graphically in Fig. 5. Asphalt

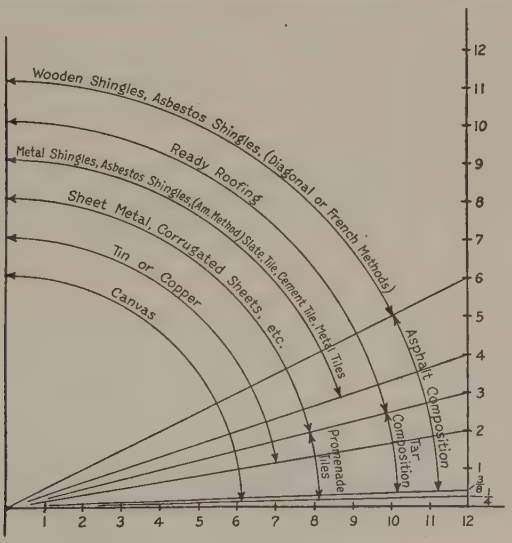


FIG. 5

roofing is sometimes laid to a steeper pitch than shown, but it would be safer to confine it under 6 to 12, as indicated in the illustration.

276. Box Gutters.—When a box gutter is used, it should be as large as possible, with a good clear drop from the butts of the shingles. A hanging gutter is the best gutter to use where it is possible to do so. Box gutters demand great care in designing.

277. Canvas Roofing.—Canvas is sometimes used to cover porch and balcony roofs that are to be used as upper porches. A 12-ounce canvas duck should be used for this purpose. It should be well wet before laying and should be laid in a thick coat of white lead. All seams should be well lapped and it should be tacked with tinned carpet tacks or copper tacks. After the canvas has been laid, and before drying, it should be well soaked with pure boiled linseed oil and then given two or three coats of white lead and boiled linseed oil.

278. Shingles.—Shingles wider than 7 inches should not be allowed, as they are apt to curl. Shingles should have two nails apiece and should not be laid more than 5 inches to the weather.

279. Pitched Roofs.—Pitched roofs under 45° should be shingled very carefully, and shingles should have four laps if possible. The joints should be broken in the center of the under shingle.

280. Hips.—Hips at an angle of 45° on the plan are the only ones suitable for a *Boston hip*, as unequal angles make unequal widths for the shingles on opposite sides of the hip. Where roofs on either side of the hip have unequal pitches, the shingles would have different widths to the weather on the two pitches if desired that the butt lines of the hip shingles should coincide with those of the roof. This does not look well, however, and is very seldom done.

281. Gambrel-Roof Valleys.—The valleys of gambrel roofs should be wide, especially on the low pitch, and the edge shingles should be raised on a cleat to prevent water from working back under the shingles by capillary attraction.

282. Slate Roofs.—Roofing slate comes in fourteen sizes running from $6'' \times 12''$ to $14'' \times 24''$, the standard thickness being $\frac{3}{16}$ inch. Special slates for laying graduated slate roofs come in thicknesses running from $\frac{1}{4}$ inch to 1 inch and in random widths. Slate should have nail holes drilled and countersunk. Before laying slate roofs, the entire surface of roof should be covered with heavy asphalt-saturated roofing felt, nailed with large-headed galvanized nails. Slate should be nailed with either copper, brass, or galvanized nails. Eaves courses, ridges, and valleys should be bedded in elastic roofing cement. Bedded slate roofs are used for flat roofs where considerable walking is liable to be done. The roof surface is covered with felt and a mixture of asphalt and coal-tar pitch over which is laid a special bedding compound in which the slate is bedded, butting joints.

283. Slate Testing.—To test a slate, place on edge in water; if after 12 hours the water of absorption reaches the top, the slate should be rejected. If it rises about $\frac{1}{8}$ to $\frac{1}{2}$ inch, it may be considered good. Good slate is smooth, but not greasy to the touch.

284. Types of Roofing Tile.—There are a number of types of roofing tile on the market, the principal ones being Mission, Spanish, Shingle, Roman, and Interlocking. They are generally made in reds, but may be obtained in greens, browns, or other colors as desired. Enameled and glazed finishes may be had as well as the plain finish. The effect of a single tile gives little or no idea how the finished roof will appear, so it is well to see the tiles laid in the mass on roofs before deciding on what type or color to use.

285. Laying Roofing Tile.—Before laying roofing tile, the roof sheathing should be covered with a heavy saturated felt. If mission tile are used, the roof should be stripped with $1'' \times 4''$ strips coming under each cover tile. All hip, ridge, and verge lines should be laid in mastic, or elastic, cement and tiles should be nailed with copper, zinc, or galvanized nails. Hips and ridges should be formed with special hip and ridge tiles and Spanish and Mission tiles should have special eaves closures.

286. Laying Tin Roofs.—Tin roofs are laid with flat seams, standing seams, or ribbed seams. Flat-seam roofs are used on roofs having a pitch of 3″ to 12″ or less, and standing-seam and ribbed-seam roofs are laid on roofs having a pitch from 3″ to 12″, to 7″ to 12″, or steeper. All seams in tin should be locked together and well soaked with solder. The sheet should be fastened to the sheathing boards by means of cleats locked into the seams and nailed to the roof. No nails should be driven through the sheets. Solder should be what is termed *half and half*, that is half tin and half lead, and should be made from new metals. Rosin should be the only flux used in soldering tin roof, and all rosin, etc., should be thoroughly cleaned from the roof before painting.

287. Painting Tin Roofs.—The painting of tin roofs should be done immediately after laying. If the surface of the tin is so oily as to prevent the proper adhesion of the paint, it should be washed with strong soap and water and thoroughly dried before painting. A tin roof should not be allowed to remain unpainted in order that the oil may evaporate or be washed off by rain; this is a very common but reprehensible practice. The under side of the tin, also, should always be painted before laying.

288. Copper Roofing.—Copper roofs are probably best laid with roll, cleat, or standing seam, unless flat, when a lap seam soldered and fastened with cleats is best. In all these cases, the great expansion and contraction of this metal should be kept in mind and provided for by using double-locked seams, clips, etc. Copper plates made in the form of shingles or tiles are also used.

Copper is probably the best material available for roofing purposes on account of its toughness and durability.

Sal ammoniac or chloride of zinc is used as a flux for copper soldering, and half-and-half for solder.

289. Laying Sheet Zinc.—The methods of laying zinc roofing are similar to those used for copper. Paper should be laid under zinc, as it is very susceptible to wood acids. No other metals should be used in connection with zinc because of the liability to chemical action and the great amount of difference in expansion and contraction of the different metals. Zinc nails should be used.

290. Asphalt Shingles.—Asphalt shingles are composed of single thicknesses of heavy felt saturated and covered with asphalt, with finely crushed slate, or a similar material pressed into the top coating. The shingle may be single, about 8 inches wide and 12 inches long; double, or about 16 inches wide and 12 inches long; and strip, or 32 inches wide and 10 inches or 12 inches long. The double shingle is slit at the butt to represent two shingles, and the strip is slit to represent four shingles. Asphalt shingles are laid in the same manner as wooden shingles, with 4 inches exposure to the weather.

291. Composition Roofs.—For flat roofs, tar and gravel or tar and slag roofs make a very good roof covering. The best roofs are five-ply, but a four-ply makes a good roof over boards and three-ply is good on concrete. The roof is built up by putting down heavy saturated felt, which should weigh not less than 15 pounds per 100 square feet, mopping it with hot coal-tar pitch, laying another layer of felt, lapping the ends and edges, again mopping with pitch, until the required number of plies are laid, mopping the whole roof with pitch and covering with gravel or granulated slag. For roofs over boards a dry sheet of felt should be laid before laying the pitched felt, to prevent the pitch running through the cracks between the boards. On concrete slabs the slab should be mopped with pitch before laying the felt.

292. Asphalt roofs are another type of built-up roof laid in a manner similar to tar and gravel roofs, except that asphalt is used instead of coal-tar pitch and the protective covering of slag or gravel is omitted. This can be done, as the melting point of asphalt is much higher than that of coal tar.

293. Flashing and counterflashing for tar and gravel or asphalt roofs should be of tin, copper, or galvanized iron which is applied the same as for other roofs. Strips of saturated felt are also used for flashing these roofs. It is desirable, however, that the cap flashing be made of sheet metal, especially against masonry walls.

HARDWARE

294. Specifying Hardware.—Hardware manufacturers issue voluminous catalogs from which the architect may select and specify locks, butts, and other necessary hardware with great exactness. He should therefore obtain the catalogs of the reliable firms and make selections therefrom.

295. Window weights in common use are made of cast iron, and are about $1\frac{3}{4}$ inches in diameter with a perforated and flattened end through which the cord or chain is fastened. Sectional interlocking weights that are rectangular instead of round are now made. They are built up from below, to correspond with the weight of the sash.

Lead weights are used sometimes for heavy sash or where weight space is limited.

296. Iron Nails.—Iron nails are either *cut*, *wire*, or *wrought*. Wrought nails are rarely used. Nails are graded by their lengths. They are made from 1 to 6 inches long, or from twopenny to sixtypenny.

297. Nail Sizes.—The sizes of nails used for different purposes are as follows:

	Size, in Pennies
Framing	10, 20, 40, and 60
Sheathing, rough flooring, cross-bridging, etc.	10
$\frac{3}{4}$-inch ceiling and flooring	8 to 10
$\frac{1}{2}$-inch ceiling and flooring	4 to 6
Inside finish	2 to 8
Clapboards	6
Shingles, slating, lathing, etc.	4

298. Copper, brass, zinc and galvanized nails are also made and used for slating, in wet positions, and for work near the sea. Copper and zinc nails are used in places where iron would not be suitable because of its magnetic action.

299. Screws are made of iron, steel, copper, bronze, brass and phosphor-bronze. The ordinary screw is of iron, and may be electroplated to match the different hardware finishes, and have round, oval, or flat heads.

For finished woodwork, where expense will allow it, screws are to be preferred to nails.

300. Screw Gauge.—The American screw gauge should be used in specifying screws, which varies from 0 to 30, with diameters from .0578 to .4526 inch. The lengths vary from $\frac{1}{4}$ inch to 6 inches.

301. Lagscrews, used sometimes for framing, are made from $\frac{5}{16}$ to 1 inch in diameter and from $1\frac{1}{2}$ to 12 inches in length.

302. Hand-rail screws are used to fasten together different parts of stair hand rails, and are $\frac{3}{8}$ and $\frac{5}{16}$ inch in diameter and 4, $4\frac{1}{2}$, and 5 inches long. They are threaded at both ends, and have a square nut at one end and a notch-edged nut at the other. The latter nut is used to tighten up the bolt through a hole in the rail after the bolt is in place.

303. Expansion bolts are made of iron, brass, and bronze in many different patterns, and are used to fasten wood or other work to brick or

stone. They consist of a bolt having either a screw or bolt head, which screws into a shell divided longitudinally into parts that spread as the bolt advances, thus causing the shell to grip the sides of the hole. These bolts vary from $\frac{1}{4}$ to 1 inch in diameter.

304. Adhesive Strength of Wire Nails.—The adhesive strength of smooth wire nails clean or dipped in asphalt, as ascertained by tests made

TABLE I

ADHESIVE STRENGTH OF WIRE NAILS

Description of Nails				Length Driven Nails	Total Adhesive Resistance Pounds	Average Pounds
Name	Size Pennies	Diameter Inch	Total Length Inches			
Common smooth.....	10	.145	2.99	2.50	136	
Common smooth.....	10	.145	2.99	2.50	144	167
Common smooth.....	10	.145	2.99	2.50	220	
Coated.....	10	.117	3.00	2.50	414	
Coated.....	10	.117	3.00	2.50	406	418
Coated.....	10	.117	3.00	2.50	435	
Common smooth.....	9	.132	2.83	2.25	226	
Common smooth.....	9	.132	2.83	2.25	125	182
Common smooth.....	9	.132	2.83	2.25	196	
Coated.....	9	.114	2.68	2.25	345	
Coated.....	9	.114	2.68	2.25	318	327
Coated.....	9	.114	2.68	2.25	317	
Common smooth.....	8	.132	2.52	2.00	146	
Common smooth.....	8	.132	2.52	2.00	228	189
Common smooth.....	8	.132	2.52	2.00	192	
Coated.....	8	.112	2.39	2.00	322	
Coated.....	8	.112	2.39	2.00	318	316
Coated.....	8	.112	2.39	2.00	309	
Common smooth.....	6	.097	2.05	1.625	100	
Common smooth.....	6	.097	2.05	1.625	112	106
Common smooth.....	6	.097	2.05	1.625	105	
Coated.....	6	.092	1.94	1.625	214	
Coated.....	6	.092	1.94	1.625	218	226
Coated.....	6	.092	1.94	1.625	247	

at the Watertown Arsenal, Massachusetts, is given in Table I. (Nails driven perpendicular to the grain of the wood; all nails driven in the same stick.)

305. Holding Strength of Cut Nails.—A cut nail is harder to drive than a wire nail and has a greater adhesive strength, but loses about 40 per cent. of its adhesive value when slightly started. In a series of tests made at the United States Arsenal, cut nails were found to possess more holding power in every case than wire nails.

306. Facts About Nails.—The *point* on a cut nail adds 30 per cent. to its holding power, and on a wire nail, about 100 per cent.

Where much vibration is to be encountered in timber work, the wire nail is probably the better to use, as it is less easily loosened than the cut nail.

The holding strength of a nail increases with its length, but not according to any simple law.

Nails driven across the grain hold better than nails driven with the grain.

307. Holding Strength of Screws.—The force required to withdraw an ordinary 2-inch screw driven through a $\frac{1}{2}$-inch hardwood board and into a hardwood block has been found to be 790 pounds, and 395 pounds when soft wood was used.

308. Sash Appliances.—Cheap sash pulleys or spring sash balances should be avoided in good work.

A great many sash locks are manufactured, and care should be taken in making a selection to get one that pulls the sash firmly into position when locked and which cannot be thrown by slipping any instrument between the meeting rails.

The best quality of cord or chain should be selected for hanging windows.

Pivots for sash are now manufactured which make it possible to revolve the sash either at the center of the hanging stiles, or, at the center of top and bottom rails. This enables the washing of the entire window from the inside, and does away with weight boxes.

309. Stop-Adjuster.—A stop-adjuster should be used to fasten window stops. These adjusters allow slight changes in the position of the stops to take care of any shrinkage that may occur.

310. Casements should be fitted with rod adjusters by means of which the sash may be fixed rigidly when open and thus be prevented from banging in the wind. Also, they should be fitted with turnbuckles to lock them closed or cremorne bolts, and, in the case of large casements, espagnolette bars. If cremorne bolts or espagnolette bars are used, the sash should have astragals of sufficient size to accommodate them.

311. Butts for blinds should have swing enough so that the blind may be thrown back against the building and fastened in that position. An adjuster is now made by means of which the blinds may be opened or shut from the inside of a room without opening the window.

312. Style of Hardware.—The finished hardware for a modern interior may be had in any style to harmonize with the style of the rooms, and the surface finishes afford a very wide choice. In specifying hardware for special conditions, it is best to consult with a practical hardware man, as improvements are constantly being made, which may escape the notice of the architect.

313. Terms Applied to Swing of Doors.—In considering the swing of a door, one is always supposed to be standing outside. A left-hand reversed door is one swinging out and to the left. A right-hand reversed door is one swinging out and to the right. A left-hand regular door is one swinging in and to the left. A right-hand regular door is one swinging in and to the right. Ordinary bedroom doors are left- or right-hand regular.

314. Door Bevels.—The hand of a door has much to do with the bevel of the latch bolt or the front of the lock where the stile is beveled. Some locks are made reversible; that is, they may be used regular or reversed.

The meeting rails of sliding doors are either beveled, beveled astragal, rabbeted, or plain, and this should be kept in mind in ordering or specifying the locks.

The usual bevel for doors is $\frac{1}{8}$ inch in $2\frac{1}{4}$ inches. It should be stated whether the doors have beveled edges or plain.

315. Door butts should have swing enough so that the door will clear the trim when wide open, and the number of butts should be sufficient to carry the door. Doors over 7 feet high or 4 feet wide should have three butts. The loose-pin butt is preferable to the fast-joint butt, and should have not less than five knuckles.

316. Door Hinges.—Double-acting door hinges are used for doors between pantry and dining room or pantry and hall, etc. Such doors should have push plates, and should be fitted with hooks and eyes to fasten them open if necessary.

317. Door hangers with track for sliding doors are made in a number of types, and care should be taken in making a selection. Noiselessness, strength, and adjustability are points to be considered.

318. Door Checks.—Where doors are used frequently and are liable to be left open, door checks should be used. These checks contain springs that throw the door shut and oil or air cushions that take the impact and allow the door to close gently.

319. Locks.—The number of keys desired for each lock and whether or not master keys are desired should be stated in the specification. For very cheap work, rim-tumbler locks are suitable. For the best work,

mortised-tumbler or cylinder locks should be used. The greater the number of tumblers, the greater is the security.

320. Strike Plates.—Where security is an essential point and stops are not housed into the jamb, a protected lock-strike should be used. This strike plate has a projection that covers the crack between the wooden stop and the jamb, through which a knife blade or a thin paper cutter may be thrust to throw back the latch. The rabbeting of the stop into the jamb of course obviates the necessity for the use of such a strike.

321. Door knobs are made of glass, china, wood, and metal, and are usually flattened spheres or ovals. Mahogany doors are often fitted with cut-glass knobs, which present a very rich appearance.

322. Door bumpers of wood or metal with rubber tips are usually placed behind doors to prevent the door knobs from striking the plaster walls.

323. Bolts.—The standing leaf on all double doors should be fitted with bolts at top and bottom, either flush bolts set into the edge of door or surface bolts on the face of door, and in heavy work chain bolts at top and foot bolts at bottom. Entrance doors and interior doors may be fitted with mortise bolts with thumb turns. Cellar windows and doors in cheap work may be fitted with barrel bolts.

324. Panic Bolts.—School houses and places of public assemblage should have the exit doors equipped with panic bolts. These bolts are controlled by means of a horizontal rod extending across the door and any pressure on the rod releases the bolts, allowing the doors to open. Doors may be locked with a key from the outside, but are never locked from the inside.

325. Kick plates should be placed on swinging doors in public dining rooms, between pantries and the dining room, and on the entrance doors to stores, office builings, etc.

PAINTING

326. Preparation of Woodwork.—Before painting, woodwork should be seasoned and dry and free from dust, and the quirks and cracks should be thoroughly brushed out. Painting in frosty weather is quite likely to result in blisters, due to small quantities of frost that remain under the paint. All wood should be smooth, and the knots should be thoroughly shellacked.

327. White lead is principally lead carbonate with from 15 to 25 per cent. of lead hydrate, and as sold to the customer is ground in linseed oil. It is made either by the *corrosion process*, by the *precipitation process*, or is *sublimed*, and varies considerably in the proportions of the component parts. Pure white lead is ropy when lifted from the pail with a knife.

The adulterants used in white lead are sulphate of lead, sulphate of lime, whiting, chalk, zinc white, etc.

328. Red lead is an oxide of lead prepared by burning litharge or red oxide of lead in a furnace. The adulterants used are oxide of iron, brick dust, etc. Oxide of iron is made from iron ore.

329. Linseed, or raw, oil is recognized as preeminent for use in paints, but as there are a great number of other drying oils and about thirty non-drying oils to be had, it is evident that the purity of the linseed oil used is a matter of great importance and one that the architect should look into thoroughly.

330. Boiled oil is a combination of raw oil and driers boiled, which improves the drying qualities of the oil. Boiled oil dries in about one-half the time that it takes for raw oil. It is used for interior work and in grinding colors. Boiled oil is also used for outside work, and it gives a gloss to the paint; it is much darker in color than the raw oil.

331. Drying and Non-Drying Oils.—Linseed oil, poppy oil, hemp oil, etc., are drying oils. Non-drying oils are cottonseed, olive, castor, etc., and are not suitable for paints or varnishes, as they do not dry and also contain elements that decompose.

332. Turpentine is a product of distillation of the sap obtained from the long-leaved yellow pine, rosin being the residue. Turpentine is used as a thinning agent and to dull or flatten paints and varnishes.

333. Zinc white is oxide of zinc and is the finest and whitest of all the white pigments. Its covering qualities are not as good as those of white lead, and, when used alone, will crack with seasonal changes. When mixed with white lead, it stabilizes that pigment and checks its rapid disintegration.

334. Naptha, benzine, and **petroleum** are mineral oils used as solvents in bituminous, asphalt, and coal-tar paints.

335. Coloring Paints.—The different colored paints are obtained by mixing the various color pigments with white lead or zinc white and linseed oil, except the metallic paints, which use an inert pigment with oil and a drier, the color being usually controlled by the pigment.

336. Fugitive Colors.—The following oil colors should be avoided as they are fugitive or apt to fade:

Violet carmine	Gamboge	Prussian blue
Burnt carmine	Green lakes	Prussian green
Yellow carmine	Indigo	Rose lake
Carmine	Italian pink	Sap green
Citron yellow	Mauve	Verdigris
Crimson lake	Olive lake	Yellow lake

337. Distemper Paints.—Distemper or cold-water paints are used for painting wood, stone, or brickwork, and are made of pigment mixed with water and glue, or some other like substance for a binder.

Distemper paints are much darker when first applied, becoming lighter in drying out. Enough mixture should be provided to do an entire room at one time, as it is very difficult to match a tint in making a new supply of paint. Washable distempers have just enough oil in them to be insoluble in water. The relative cost of distemper, washable distemper, and oil paint is about 1 to 2 to 3.

338. Flat wall paints are quite extensively used at the present time. They are composed of lithophone, which is a combination of zinc sulphide and barium sulphate, and china wood oil, sometimes called *tung oil*. These paints give a perfectly flat surface and may be washed, but care must be taken not to use a lye soap.

339. Ready-Mixed Paints.—Ready-mixed paints can be obtained for almost all purposes. Their use obviates the necessity for mixing the ingredients. These paints, being mixed by machinery, are generally uniform in proportions and materials.

340. Varnishes are solutions made by cooking fossil resins or gum with oils, either linseed or china wood oil, adding a small proportion of lead and manganese salts as dryers and thinning with volatile solvents, either turpentine or benzine, or a mixture of both, to facilitate the spreading of the varnish. Varnishes are divided into two classes; one containing a large proportion of oil and known as *long oil varnish*; the other containing a preponderance of gums, is known as *short oil varnish*. Varnishes should never be thinned before using.

341. Fillers are used to fill the open portions in the grain in woods, so as to obtain an even and impervious surface for the varnish coat. There are two kinds of fillers: liquid and paste. Liquid fillers are composed of gloss oil, a little linseed oil, and a pigment, either china clay or asbestine. Paste fillers are made by grinding together silex (powdered quartz), linseed oil, and Japan drier. Paste fillers are best for most classes of work. Liquid fillers should never be used on floors or for exterior purposes.

342. Shellac is a spirit or alcohol varnish, the white shellac being a solution of bleached lac, while the orange shellac is a solution of the natural lac. *Grain alcohol* should be used to dissolve the lac, and not *wood alcohol*.

343. Knotting.—Shellac is sometimes called *knotting*, because it is used to cover knots before painting to prevent the exudation of sap.

Shellacked, primed, and stopped mean the knotting, priming coat, and puttying, which makes ready for the second and following coats.

344. Putty.—Putty should be composed of whiting, white lead, and pure linseed oil. The use of oils other than linseed causes the yellow spots over nail heads that are often seen on otherwise good work.

345. Driers are substances such as litharge, sugar of lead, antimony, and sulphate of zinc, and are used to hasten the drying of varnishes or paints. They should be used with moderation.

346. Japan drier is made of shellac and linseed oil cooked together with a drier added. It is thinned with turpentine.

347. Enamels are generally classified as varnish paints, and may be had in white and in colors, in gloss, dull, or eggshell finish. They are made up of lithophone, varnish gums, oils, etc., the different manufacturers using different materials and different processes. For that reason they should always be applied according to the manufacturers' instructions. Quite a few manufacturers make special undercoaters for enamels, others may be applied on a foundation of successive coats of white lead or white lead and zinc white. The first coat under the special undercoater should be of white lead.

348. Rosin dissolved in turpentine is used for cheap varnishes, but makes a very inferior finish that will scratch white.

349. Stains are liquid preparations which are applied to the surface of woods either for the purpose of imitating more expensive woods or to obtain unique color effects. They are divided into four general classes: oil stains (aniline); spirit stain (aniline); oil stains (pigments); acid stains, which are sometimes called *water stains*, which is a more logical name, as they contain no acid, but are a solution of various dyes in water. Acid stains are the best for most uses, but they raise the grain of certain woods. In staining open-grained woods the stain is sometimes mixed with the filler.

350. Shingle stains are generally mixed with creosote and are made in a great variety of colors.

351. Coats of Paint Required.—New work should have at least two coats of paint following the priming coat; three coats will give the best results, however.

Painting over old work, if it is in fair condition, will require only two coats of paint, unless the old work is dark and the new is to be light, in which case probably three coats will be needed.

352. Durability of Paint Work.—Exterior work, when well done, should remain in good condition for about 6 or 7 years; inferior work, however, lasts only about 3 years. Interior work should last from 10 to 30 years, according to how well it is done.

353. Causes of Blistering and Cracking.—*Blistering* is due to wet or frosty wood, pitchy spots not properly treated, too much oil in paint used on the surfaces much exposed to the sun's heat, or too little time allowed between coats. Cracking of paint is due to too much oil in the under coats and too little in the top coats.

354. Applying Paint.—Paint should be put on with strokes parallel with the grain, and, where possible, the painter should make the strokes the full length of the pieces.

Hardware may be saved the daubing and spattering by painters if it is fitted and then removed until the painting is done, when it is again replaced. The window glass should also be protected from spattering paint, which is sometimes difficult to remove.

A gloss may be given to a paint by the addition of copal, or other oil varnish.

355. Outside Priming Coat.—Priming coats should be mixed differently for different woods on account of the greater or less amount of sap in the wood and the difference in the grain. With but few exceptions, white lead mixed with linseed oil and turpentine should be used for the priming coat. Yellow pine and cypress, on account of their sappy nature, should be primed with red lead mixed with equal parts linseed oil and terpentine. Except in the case of red lead, the priming coat should be tinted to correspond in tone to the proposed final coat, it should be well brushed on and should be followed by a thorough puttying of all nai holes, cracks, etc.

All the finished work, as far as possible, should be primed before leaving the shop, except where spruce is used, in which case it should not be painted until it has been exposed to the weather for at least 30 days. Too long an interval should not be allowed between the priming coat and the one next following.

356. Inside Priming Coat.—White lead, mixed with linseed oil and turpentine, makes the best inside priming coat, except for yellow pine and cypress, which should be primed with one-third red lead, and two-thirds white lead mixed with equal quantities of linseed oil and turpentine. If zinc white is used, it should be in the second and the following coats, as it has less body and filling quality than white lead. The priming coat should be mixed thin, but not too thin.

357. Paint for Floors.—Floors are painted with lead-and-oil paint, with varnish added to give the paint a harder and more glossy surface and to hasten its drying.

358. Paint for Brick Walls.—Brick walls usually require about two coats of white lead and linseed oil paint, colored as desired. One-half gallon of linseed oil is added to each gallon of paint for the first coat.

359. Painting Plastered Walls.—Newly plastered walls should not be painted nor papered immediately, but should be allowed to stand at least 3 months and should then be coated with a good liquid filler or with a thin glue sizing, and the blisters or unslaked spots cut out and stopped before painting or papering is done. Glue size may be prevented from decomposition by the addition of a small quantity of carbolic acid or essence of peppermint or cloves. Old painted walls need only be washed thoroughly with soap and water and cleaned of all loose scale before painting. Two coats will usually be sufficient. Large surfaces should be stippled to obtain a good effect.

360. Painting Iron Work.—Ironwork should be thoroughly cleaned of all rust, scale, dirt, etc., before painting. This should be done by washing with benzine, brushing with wire brushes, scraping, or tapping with hammers. The durability of the paint which is applied to ironwork depends largely on the thoroughness with which this cleaning is done. Ironwork should always be primed with red lead mixed with raw linseed oil, before applying any finishing coats, which may be white lead and oil. Where merely protection is desired a good graphite paint may be used.

361. Blackboard Paint.—Paint used for blackboards may be made with silicate of soda (soluble glass) and water in equal parts, with just enough lampblack added to color it.

362. Fire-Retarding Paint.—A fire-retarding paint may be had by using alternate coats of silicate of soda and lime wash. Tungstate of soda and asbestos paints are also used.

363. Whitewash as Fireproofing.—A whitewash coating on the entire framework of a building is an inexpensive method of adding considerably to its fire-retarding qualities. A fireproof paint could also be used, but would be more expensive.

364. Paint for Tin Roofs.—Tin roofs should be painted with red lead, iron oxide, metallic brown, or Venetian red mixed with pure linseed oil, using no turpentine nor patent dryers. Galvanized sheet-metal work should be cleaned with vinegar, or washed with benzine and coated with a solution of 6 ounces of copper acetate to a gallon of water. It is then primed with red lead mixed with one-third boiled linseed oil and two-thirds raw linseed oil, after which it may be painted with white lead and oil.

365. Cleaning Paint Work.—To clean paint work, rub with a paste of whiting and water and afterwards wash and rub dry with a soft cloth.

366. Painting Old Woodwork.—Where old woodwork is to be painted, all loose scale and dirt should first be removed by solvents, scraping, or burning. Where a light color is placed on a darker one, a greater number of coats will be required than if the base color were light or a dark color were placed over a lighter color.

367. Removing Old Paint.—Old paint may be removed by means of quicklime, naphtha, wood alcohol, caustic soda, or a gasoline torch.

368. Paint Removers.—Solutions or pastes for softening paint and varnish are on the market. When used, all traces of the remover should be taken off before the wood is refinished.

369. Specifying the Varnish.—The architect should decide on some good varnish to be used and determine by tests that it is pure. This varnish should be specified by its name or number, and the architect should insist on its being delivered at the building in sealed packages.

370. Varnishing Temperature.—Varnishing should be done in a temperature of about 70° F. with the air as free from moisture as possible.

371. Dull and Bright Finish.—A good job of varnishing may be obtained with two or three coats of varnish besides the filler. If a dull surface is desired, the under coats should be rubbed down with sandpaper or curled hair to take off inequalities, and the last coat rubbed with pumice or rottenstone and oil or water. If a bright gloss is desired, the last coat should not be rubbed, or only very slightly. Care should be taken to clean the pumice, etc., out of quirks, cracks, etc.

Dull surfaces for varnish may also be obtained by the use of dead varnishes, or those containing wax or other substances that give a surface similar in appearance to a rubbed varnish. Paint may be rubbed to a dull surface in the same manner as given for varnishes.

372. Varnishing Close- and Open-Grained Wood.—Close-grained woods which are to be varnished should be stained, given a coat of shellac to prevent the stain from bleeding through, and then varnished. If the wood is to be finished natural, the shellac should be omitted. Woods of this nature are white pine, yellow pine, poplar, cypress, maple, birch, gum, cedar, sycamore, California redwood, etc. Open-grained woods which are to be finished should be filled with a paste filler colored the desired shade or stained after filling. If stain is used, the work should be shellacked, and then varnished. Woods of this nature are oak, ash, chestnut, walnut, mahogany, rosewood, teak, etc.

California redwood is very susceptible to linseed oil, which makes a chemical combination with the acids in the wood. Therefore, it should be given a coat of shellac before applying any varnish to the surface.

373. Floor Varnishing.—If floors are to be varnished they should be filled with paste filler when an open-grained wood is used, coloring the filler to obtain the desired shade. If a close-grained wood is used, it should be stained with an oil stain, then given two coats of floor varnish, which is a special quick drying, hard varnish. The finishing coat may be left in the gloss or rubbed to a dull finish with pumice stone and oil. Shellac, on account of its brittleness, should never be used as an undercoater on floors.

374. Wax Finish.—Where a wax finish is desired on a varnished surface, use beeswax dissolved in turpentine, to the consistency of oil. This is applied with a brush, and after being dried, is followed with a coat of the consistency of clotted milk. This coat should be rubbed with a soft cloth until dry.

Prepared wax finishes of excellent quality can be obtained.

GLASS

375. Window Glass.—The window glass used in buildings is designated as either window, crystal sheet, plate, art, or obscured glass. Window glass is the ordinary blown glass, and can be had in four grades; *AA*, *A*, *B*, and *Fourth Quality*. The *A* grade is specified generally when a good grade of window glass is desired. All four grades are made in two thicknesses, known as *single-strength* and *double-strength*.

Single-strength glass measures about 12 thicknesses to the inch, and weighs from 16 to 18 ounces to the square foot. It can be obtained in sheets up to 24″×60″, 30″×54″, or 36″×50″.

Double-strength glass measures about nine thicknesses to the inch, and weighs from 22 to 24 ounces to the square foot. It can be obtained in sizes up to 30″×90″, 38″×86″, or 48″×80″. The larger sizes in double-strength glass, as well as in single-strength glass, should be avoided on account of the distorted vision due to waves, and to the liability of breakage.

Crystal-sheet glass is a blown glass made heavier than double-strength glass. It measures from about $\frac{1}{8}$ inch to $\frac{3}{16}$ inch thick, and is made in three qualities, *AA*, *A*, and *B*. It is made in four weights, 26, 29, 32 to 34 and 39 ounces to the foot.

376. Plate glass is used in the best work and does not distort objects viewed through it as does sheet glass. This glass is usually $\frac{1}{4}$ inch thick and weighs $3\frac{1}{2}$ pounds per square foot; $\frac{3}{8}$-inch glass may be had where heavier glass is necessary. It may be obtained in even inches up to 12′ 0″ ×17′ 0″.

Glazing quality is generally specified, the best quality is *silvering* which is used only for mirrors. The best grade is *French silvering*. Where plate glass is used in doors or other places where it is liable to be jarred, it is sometimes bedded in rubber, one strip being glued to the glass and the other to the face of the rabbet.

377. Non-shattering glass is a special glass used in screens around cashiers' desks, in banks, etc. It is made up of two pieces of polished plate glass, with a sheet of celluloid between them and welded together under a high temperature and a tremendous pressure. If struck by an ordinary missile it will not shatter nor fly as strong impacts only cause a multitude of hair-like cracks, but no breaks or flying splinters.

378. Obscured glass is used for windows of lavatories and the like, and is made in several different surfaces, as *ground, frosted, chipped*, etc.

379. Wire glass is used in metal sash where a building is exposed to danger from fire, as in elevator shafts, on sides adjoining other buildings, etc. This kind of glass has a woven wire netting embedded in it, and although it may crack or partly melt under great heat, it will remain in position and prevent fire from breaking through.

380. Prism glass is made in individual prism lights that set in a metal framework, used in vault lights, or of sheet prism glass cut to any size desired smaller than 60 inches×138 inches. It is used for skylights, windows, etc. This glass is usually set in squares of from 4 to 6 inches, and is held in place by metal muntins.

The prisms and sheet prisms are used to throw light, by means of refraction, from between high buildings or over store windows to the interior of buildings, and are a great help to stores or offices of such depth as to be poorly lighted. Prism and prism glass are made by a number of companies, who issue catalogs that clearly explain their uses. Polished plate prisms may be obtained in sheets up to 72 by 82 inches.

381. Art glass is used for church windows, and for decorative windows in residences. All types of glass already mentioned and many other colored, crinkled, or frosted glasses are used in this work. The glass is outlined in different designs by lead or copper cames.

382. Setting Large Window Panes.—Store-front panes are set in patent frames or in cast-iron angles with wooden stops, and it is very necessary to keep the glass from coming in contact with the iron; felt, leather, and rubber are used for this purpose. The joints should be made tight with red-lead putty. The stops in this work should be fastened with screws so that they may be easily removed for repairs.

383. Puttying Windows.—For glazing steel or hollow metal windows a self-hardening putty, made up of linseed oil, whiting, white lead, and litharge, which is lead monoxide, or one of the various patent glazing compounds, should be used as ordinary putty, and will not harden on metallic surfaces. Putty for wooden sash should be made of pure raw linseed oil and whiting and white lead. Tallow is sometimes added where the panes are large and liable to movements due to expansion and contraction. All glass should be bedded in a layer of putty and should be secured by triangular points of sheet zinc, which are covered by the final puttying. When steel sash are used, special glazing points are furnished by the manufacturer.

384. Cames.—Cames, or muntins, for art glass are of several shapes, the common types being shown in Fig. 6. The type shown at (*a*) is made of lead in several sizes and styles, and is called *colonial lead;* (*b*) is the commonly used lead, is called *flat*, and is made in several sizes; (*c*)

and (*d*) are of copper or hard metal and are made in several sizes and sometimes reinforced, as shown at (*c*), with a steel strap.

385. Water-Tight Leading.—The joint between the glass and the lead muntin is made water-tight by brushing with whiting and red lead and then with black lead. A grip is given to this cementing by the milling on the bearing surfaces of the leading.

386. Saddle Bars.—Leaded glass lights are stiffened and often entirely supported by horizontal saddle bars of square or round section. They are made of iron, steel, zinc, or copper, and are wired and soldered to the leading.

Broad lights of more than 30 inches in wooden sash should have the additional support of saddle bars fixed to the frame and wired and soldered

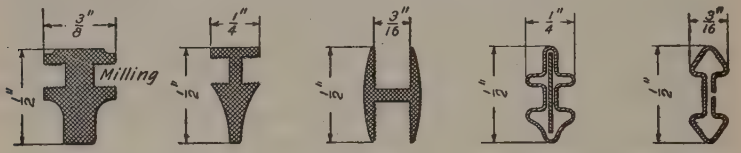


FIG. 6

to the sash. Vertical bars are called *stanchions*, and horizontal bars, *saddles*.

Saddle bars and stanchions are sometimes let into stone jambs, head and sill.

387. Art-Glass Skylights.—Skylights of art glass are used with good effect, but should of course be under and protected by an outer or exposed skylight.

388. Wooden Sash for Leaded Glass.—For residences, the wooden sash in which leaded glass is to be inserted should be sent to the manufacturer for that purpose. This is the safest method, and the specification should state that the carpenter contractor is to ship the required sash to the manufacturer and pay the transportation charges both ways.

PLUMBING

389. General Remarks.—The plumber is usually required to do all the excavating necessary for water, gas, and sewer connections. His work usually comprises the supplying and placing of the soil and sewer lines with their necessary vents and stacks; the tapping of the corporation gas and water mains and the running of the supplies and branches to the various fixtures and faucets; the setting and connecting of pumps, ranges,

filters, or in fact any of the various fixtures and appliances used in connection with the gas, water, or sewer systems.

The nearest point at which sewer, gas, and water mains may be tapped should be ascertained by the architect, and these points should be specified and plainly shown on the drawings. If sewage is to be discharged into a cess-pool or septic tank, it should be located on the drawings, with the level of the inlet indicated.

390. Plans and Drawings.—Plans are made of each floor, showing the location of the different fixtures and the drainage and vent pipes. Sections are also made showing the back venting of traps, stacks, etc. These drawings must be approved by the plumbing department of the city in which the work is to be done before the plumber can obtain a permit to do the work.

391. Approval of Plumbing Plans.—The plumbing laws of the larger cities are complete and exacting, and it is well to make them a part of the plumbing specification by stating that they are to be so considered.

The approval of the board of health or plumbing department of the city in which work is to be done is necessary, and it should be obtained before submitting the drawings and specifications to bidders.

392. Cast-Iron Pipe.—Extra heavy cast-iron pipe should always be used except on small and unimportant work. Cast- or wrought-iron pipe should be free from sand holes, splits, and flaws.

The size, weight, and the maker's name should be cast on each length of cast-iron pipe and fitting.

393. Galvanized-iron and **lead pipes** are used for the water supply. The durability of galvanized iron depends entirely on the thickness of the coating on the interior of the pipe. Lead pipe, however, is preferable unless the character of the water is such that it acts as a solvent on the lead. Where lead pipe is used, it should be supported on shelves or some similar arrangement to prevent sags, which form pockets for sediment, etc.

The fittings for galvanized-iron pipe should be of malleable galvanized iron, beaded for additional strength.

394. Galvanized-iron pipe is sometimes partly choked with lumps of zinc; such pipe should be rejected, so as to avoid the danger of sediment, etc. lodging in it.

395. Brass pipe is used in the best work for hot water pipe, and for supply pipe throughout in many cases. Brass pipe does not corrode as does most iron pipe, nor does it sag as does lead pipe, and is also lighter in weight. It should be specified to be semiannealed seamless brass pipe.

396. Block tin or **tin-lined lead pipe** make very good pipe: the latter is sometimes used; the former is too expensive for ordinary use.

397. Terra-Cotta Pipe.—In laying terra-cotta pipe the cementing of the joints is liable to be imperfectly done and particles of mortar are often left in the pipe. To prevent this, an oakum gasket should be calked into the joint before putting in the mortar and each length of pipe should be cleaned out before the next length of pipe is laid. Mortar for joints in pipe should be mixed in the proportions of one of cement to one of sand, always using Portland cement. The grading of terra-cotta pipe should be done from hub to hub and not along each individual pipe. This insures obtaining a true and uniform grade.

DRAINAGE

398. Laying Drain Pipes.—The plumbing laws of most cities require that the terra-cotta pipe from the main sewer shall not approach the foundation wall nearer than 5 feet. In other words, the pipe from the main sewer to within 5 feet of the building may be of terra cotta, and from this point in it should be of cast iron with branches of cast iron, galvanized iron, or lead. The piping from the end of the cast-iron pipe to the sewer or cesspool is called the *house sewer*. The cast-iron piping from the terra-cotta pipe to the different stacks is called the *house drain*.

A very good job is obtained by laying the drain and sewer pipes on a concrete base, the drain pipe being laid in a brick duct with removable covers of iron at proper intervals for the purpose of inspecting or repairing.

399. Drain Pipes.—The arrangement of drainage and vent pipes should be as direct as possible. The house drain should be run above the cellar floor when possible, and should be supported on pipe rests or piers of brick or stone, or hung from the floor joists. This arrangement makes cleaning and repairing very easy, but it has the disadvantage of taking up considerable room.

Old drains should be thoroughly tested, and, unless found tight, should not be incorporated with new work.

400. Soil Stacks.—The soil pipe, or stack, is the vertical cast-iron pipe that takes the waste from water closets, basins, tubs, etc. This pipe should be extended at least 2 feet above the roof and kept as far away from dormer windows or other openings as possible. The top should be left open.

The main soil stack should not be less than 4 inches in diameter, as it not only serves as a waste pipe, but also as a vent pipe. Branch vents and other smaller vent stacks may be connected to this stack above the highest fixture.

The bases of soil stacks should be well supported on brick piers, stone corbels, pipe rests, or by wrought-iron straps suspended from the floor joists. This is often neglected, but is of great importance, as a slight settlement in the stack will open the joints between the branches and the

stack. Four-inch cast-iron pipe weighs, about 13 pounds per foot, and where a stack is 30 feet or more in height, the weight at the base is considerable.

401. Location of Stacks.—All stacks should be made as accessible as possible; they should either be exposed to view or be placed within runways with removable covers or in light or elevator shafts.

402. Soil- and Vent-Stack Sizes.—The size of soil and vent stacks with relation to the number of fixtures should be as given in Table II.

TABLE II

SIZE OF SOIL AND VENT STACKS

Diameter of Soil Stack Inches	Diameter of Vent Stack Inches	Number of Fixtures
4	2½	1 to 15
5	3	15 to 30
6	3	31 to 50
7	4	51 to 80
8	4	81 to 120
9	4½	121 to 200
10	5	201 to 300

403. Sizes of Soil and Waste Pipes.—The usual sizes of waste pipes in a plumbing system are as follows:

	Inches
Soil and house drain	4 to 6
Branches to sinks, tubs, lavatories	1½ to 2
Slop sinks	3
Water closets	4
Leaders	4

404. Cutting for Piping.—All cutting of joists, masonry, etc., necessary for the running of piping should be done by the proper tradesman—not by the plumber. Where piping runs at right angles to the joists, care should be taken to see that the carpenter does no excessive cutting, also that the cutting is done as close to the bearings as possible, so as not to weaken the joists more than necessary.

405. Fittings.—Clean-outs should be placed at proper points on the house drain, so that the branches and main up to the main trap may be cleaned out with wire, etc.

The changes in direction of drains should be made with curved pipes, **Y** branches, and $\frac{1}{16}$ and $\frac{1}{8}$ bends.

A **T** or **T Y** fitting should never be allowed in a drainage system except for the connection of the fresh-air inlet branch to the house drain.

406. Connections.—The method of making connections between the lead bend and the base of the watercloset should be carefully considered, as it is a difficult joint to make. The best method is to use one of the several types of brass floor flanges which are made by the different plumbing supply houses. The connection between the lead bend and the soil stack should be made by means of a brass ferrule wiped on to the lead bend and calked into the hub of the soil pipe.

407. Traps.—The **house trap** should be placed in a brick pit, or sump; it should have a removable cover, so that it may be accessible for repairs, etc. This trap should have two clean-out holes.

The **fresh-air inlet** should extend to the outside of the foundation wall from 12 to 16 inches above grade, and should be finished with a return bend.

After roughing-in is done, all openings of closet bends, vent pipes, etc., should be securely closed, to prevent clogging with sticks, rags, etc.

All traps should have screw clean-outs, so that they may be cleaned from time to time.

Pot, or grease, traps are suitable for bathtubs or sinks, where there is likely to be considerable grease, hair, etc. These traps should be made accessible for cleaning.

Ball traps should be used where the fixture to which it is connected is not likely to be used for long periods.

The different forms of running traps are best for general use.

408. Location of Traps.—The trap should be placed as close to the fixture as possible, so that the outlet pipe between the fixture and the trap that is unvented may be as short as possible. This is especially important in the case of urinals.

409. Size of Vent Branches.—Vent branches from traps to stacks should be of about the same sizes as the wastes from fixtures. No pipe less than $1\frac{1}{2}$ inches in diameter should be used, and for slop sinks and closets, 2-inch pipe is suitable.

410. Testing.—When the roughing-in is completed, the water or the air test is applied; and after the fixtures are set, the smoke test is made.

411. Steam System Waste Connection.—The condensation from a steam-heating system should not be connected to the house drain, but should be connected just outside of the main trap. The discharge of hot water into the cast-iron house-drain pipe expands the joints, which again contract when a large amount of water of a lower temperature is discharged into the drain or when the steam is cut off. This constant expansion and contraction will finally open up the joints and cause leakage.

412. Painting of Piping.—All exposed water-supply, soil, or vent pipes should be painted with either lead-and-oil or aluminum-bronze paint.

WATER SUPPLY

413. Sources of Water Supply.—The water supply for a building may be taken directly from the city mains or from a storage tank located either in the attic or on the roof of the building. The tank may be filled with water drawn directly from the city mains, a well, lake, or other source, by means of a pump, either hand, steam, hot air, electric or windmill, or by a hydraulic ram. Water storage tanks are always used in very high buildings. These tanks are supplied by the city mains during the night, when the water pressure is greater than during the day time, owing to the fact that less water is being used generally.

414. Water Tanks.—The tanks for water supply are constructed of various materials and by various methods. Wood, lined and unlined,

TABLE III

SIZES OF BRANCH PIPES

Supply Branches to	Low Pressure* Inches	High Pressure* Inch
Bathtubs	$\frac{3}{4}$–1	$\frac{1}{2}$–$\frac{3}{4}$
Basins	$\frac{1}{2}$	$\frac{3}{8}$–$\frac{1}{2}$
Water-closet tanks	$\frac{1}{2}$	$\frac{3}{8}$
Water-closet flushometer	1–1$\frac{1}{4}$	$\frac{3}{4}$–1
Water-closet flush pipe	1$\frac{1}{4}$–1$\frac{1}{2}$	
Sitz or foot-baths	$\frac{1}{2}$–$\frac{3}{4}$	$\frac{1}{2}$
Kitchen sinks	$\frac{3}{4}$	$\frac{1}{2}$
Pantry sinks	$\frac{1}{2}$	$\frac{3}{8}$–$\frac{1}{2}$
Slop sinks	$\frac{3}{4}$	$\frac{1}{2}$
Urinals	$\frac{3}{4}$	$\frac{1}{2}$
Outside hose faucet	$\frac{3}{4}$	$\frac{3}{4}$

*High water pressure is any pressure above 40 pounds per square inch; low pressure is anything below 40 pounds.

sheet steel, and galvanized corrugated iron are all used. Wood tanks are made up of wooden staves with iron hoops in a manner similar to barrels or of 1$\frac{1}{2}$ inch plank built rectangular in shape, bolted together on the outside to withstand the pressure and lined with lead or copper. Sheet steel tanks are generally rectangular and are riveted together. Corrugated galvanized steel tanks are always cylindrical.

Except in warm climates, precautions against freezing should be taken; the tank should be covered and proper ventilation should be supplied. A sheet iron, copper or lead safe with a waste pipe discharging into a sink in the lower part of the building, should be placed under the tank. The

discharge pipe should be taken from the side of the tank, so that sediment will not be pulled into the supply system. A draw-off pipe should be taken off the bottom of the tank and should discharge onto the roof if possible or into a sink in the lower part of the building, but should never be connected directly to the drainage system.

415. Water Pipes.—The supply pipes from street mains should be from 1 inch to 6 inches in diameter, the former size being suitable for small residences and the latter for large public buildings. For very high pressures, pressure regulators are placed on the supply pipes just inside of the cellar walls.

The branch pipes to the different fixtures should be of the sizes shown in Table III. These pipes should be exposed to view and supported by neat hangers on wooden blocks. They should also be tagged where leaving the main, so as to indicate the fixture that they supply.

416. Cocks and Valves.—A stop-and-waste cock should be placed on the water-supply pipe just inside of the cellar walls, if city water supply is used direct, and at the base of the stack, if a tank is used. All piping should pitch toward this cock in order that the entire system may be drained at this point.

Each fixture supply branch should have a valve between the main and the fixture that will allow the fixture to be cut off for repairs. Such an arrangement will avoid shutting off the water from the entire building, which would be necessary if no such valves were placed.

417. Important Considerations in Piping.—The freezing of water pipes should be carefully guarded against, and, for this reason, as much of the piping as possible should be run in the warm parts of the building. Where exposed, the piping should be protected with hair felt, mineral wool, or some other non-conducting materials.

The friction in a pipe of running water reduces the speed of the flow; consequently, by increasing the sectional area of each branch as it extends from the main to fixtures, the pressure at the faucets is kept more uniform.

Where the water pressure is heavy, the supply pipes should be extended a short distance beyond the faucets. This forms an air cushion that takes up some of the shock due to shutting water off suddenly, thus saving the strain on joints, etc.

418. Filters.—If the water supply is constantly muddy or contains much foreign matter, filters should be employed, as such sediment is not only dangerous to heath and disagreeable, but is also liable to clog waterbacks, boilers, etc. The filters are usually placed in basements on the water-supply pipes.

FIXTURES

419. Fixtures.—The fixtures are selected and specified from manufacturer's catalogs by the number of the plate and the grade. They include baths and showers, basins, waterclosets, sinks, laundry tubs, urinals, etc.

420. Circulating Hot-Water System.—The quick delivery of hot water to bathrooms and lavatories remote from the heater may be accomplished by a circulating system, or loop of pipe, which includes in its circuit the boiler and waterback. A relief pipe of small diameter with an air valve should be placed at the top of the loop, and where necessary to compel the taking of hot water from the loop in the direction of the circulation, check-valves should be placed on the line.

This loop may include a hot-water radiator, which could be used to heat a room over the kitchen or elsewhere.

421. Water Heaters.—Some type of water heater is essential in the majority of buildings, as cooking by gas is becoming more universal in all the larger cities especially in the summer, so that the kitchen range can not be depended upon for heating water except in the winter. There are a number of types of water heaters on the market using coal or gas as fuel. Coal heaters are of the magazine type, they require very little attention and are not expensive to operate. Gas heaters are of the instantaneous or storage type; for small houses with but one bath room the instantaneous heater gives good service, but for larger installations, the storage heater gives better results.

For apartment houses garbage-burning water heaters are quite frequently used. These serve a double purpose, disposing of all waste, thereby getting rid of the ill-smelling, unsanitary garbage cans, and furnishing the hot water at a very low cost, the amount of coal used being relatively small for the amount of water heated.

422. Safes.—Safes or pans of sheet lead or copper are no longer used under fixtures except shower baths, as all plumbing is now set open and free standing. Shower-bath stalls should always be set in a lead safe which should be turned up at least 4 inches on all sides to catch any leakage in the stall. A special style of trap for stalls is now made which carries off all drainage from the safe.

423. Bath tubs are made either of enameled iron or porcelain, and are either of the free-standing or built-in type. Free-standing tubs are either set up on legs or on pedestals set in the tiled floors. Built-in tubs are made either for corners or full recessed. Free-standing tubs should have standing waste and overflow. Recess tubs have the valves and wastes built into the wall, in which case a door should be provided in the back of the partition to give access to the valves. Enameled-iron tubs are cheaper than porcelain tubs.

Shower baths are frequently placed over tubs or may be set in tile or marble stalls or over enameled-iron or porcelain receptors.

424. Waterclosets.—Only two types of waterclosets are now in general use, the siphon wash-down and the siphon-jet. The latter is the better type and should always be used on the better class of work. Low tanks are now almost universally used. They are made either of vitreous china or enameled iron. Vitreous china makes the better tank, but where it is liable to get rough usage an enameled-iron tank is better as it cannot be broken as easily as vitreous china. High tanks are sometimes used on cheap work; they should be enameled inside and out.

Waterclosets should be placed in rooms with outside windows or provided with proper ventilation.

425. Urinals are either of the stall, pedestal, or trapped bowl type, but for school and factory work, trough urinals are frequently used. Stall urinals are made of porcelain with concaved backs and the receptor and waste at floor level. Pedestal urinals are made of vitreous china and are operated either by siphon jet or flushing rim. Bowl urinals are used only in cheap work. Trough urinals are usually of enameled iron.

426. Laundry tubs are made of porcelain, enameled iron, soapstone, and slate, and are desirable in the order in which they are named. A combination of laundry tubs and kitchen sink, for use in small apartments is now made in both porcelain and enameled iron. The drain board of the sink serves as a cover for the tub.

427. Lavatories are made of vitreous china, porcelain, and enameled iron. They are, with but few exceptions, made in one piece so as to avoid all joints and connections. Virteous china is the best material, as it does not crack nor craze as does porcelain, but it can not be made in large sizes, so the larger lavatories are made from porcelain. Some of the latest types of lavatories have vitreous-china spouts made into the bowl so as to reduce to a minimum the metal work.

428. Sinks are classified as either kitchen, pantry, or slop sinks. Kitchen sinks are made of solid porcelain, enameled iron, soapstone, slate, and plain or galvanized cast iron. For high-class work, porcelain is used; for medium-class work, enameled iron, soapstone, or slate sinks are used; for the cheapest work, galvanized iron is used. Special porcelain sinks for washing vegetables are used in high-class work in addition to the regular kitchen sink.

Pantry sinks are made of solid porcelain enameled iron, white metal, and tinned copper. All these various types are good, the white metal and porcelain being the most expensive. Wood or rubber mats should be used in the bottoms of pantry sinks to prevent the breakage of fine china or the enamel of the sink. Drain boards for kitchen and pantry sinks are made from wood, preferably ash, and enameled iron; some types of porcelain

and enameled-iron sinks have drain boards as an integral part of the sink. Slop sinks are made of porcelain, vitreous china and enameled iron, the best types being made in one piece with integral backs.

429. Faucets.—The faucets that supply the different fixtures should be specified very clearly. In public places, where they are liable to be left open, the faucets should always be of the self-closing type. Crown handles are the best for self-closing work, as they can not be tied nor wedged open.

Sill cocks where liable to be tampered with should be of the nut-top type to be opened with a key.

In the best class of work, the exposed metal work of all fixtures which includes faucets, supplies, traps, and wastes is usually nickel-plated; but sometimes the faucets are of plain brass and the traps and piping of lead or iron, painted with an oil paint. Explicit statements as to all these matters should be made in specifying each fixture.

430. Flush valves may be used in place of flushing tanks for water-closets, urinals, and slop sinks wherever there is sufficient water pressure. They should not be used, however, if the pressure is below 5 pounds per square inch at the valve. They are particularly well adapted for use in large buildings of a public or semipublic character, as they can not be easily tampered with and are very economical in their use of water. Those having an oscillating handle are preferred to the lever-handle type, and for public buildings, the floor push types are very good, as the user of the closet or urinal does not have to touch them with his hands.

GAS

431. Gas Mains.—The gas mains should be pitched to a low point near the meter, with a stop-and-waste cock to drain from the system the water of condensation that may accumulate. The pipe should be of standard wrought iron or steel.

432. Branch Pipe.—The branches to the outlets should be risers where it is possible, and trapping should be avoided. The outlets should not project less than 1 inch from the face of the plaster and should be securely fastened.

433. Acetylene gas is suitable for country houses, and there are a number of companies that make reliable generators. Smaller pipes are used than for coal gas, and also a different type of burner. Copper should not be used in connection with acetylene gas, as the gas forms an explosive compound with it.

434. Meters.—Connections are left at the proper point for the corporation gas meter, which is furnished by the gas company and connected

to the main with brass or lead pipe by the gas-fitter. This meter should be supported on a wooden shelf at some accessible point in the basement. A separate meter is sometimes placed on a branch of the gas stove or heater. This branch should of course be taken off the main on the outside of the regular meter.

435. Sizes of Gas Pipe.—The proper sizes of branch pipes for coal and acetylene gas and the allowable number of burners for each is given in Table IV. In the best practice no pipe smaller than ½ inch is used for coal gas.

436. Fittings.—The fittings for gas piping should be of malleable galvanized iron. The beaded fittings are preferable to the plain, as they are stronger and present a better appearance.

437. Fixtures.—Fixtures are made for gas lights alone or for both gas and electric lights. The latter are called *combination fixtures*. These

TABLE IV

SIZES OF BRANCH GAS PIPES

Diameter of Pipe Inches	Maxiumum Length, in Feet		Number of Burners	
	Coal Gas	Acetylene Gas	Coal Gas	Acetylene Gas
¼		20		4
⅜		40		7
½	30	60	4	15
¾	50	100	15	50
1	70	150	25	80
1¼	100	250	100	150

fixtures are usually purchased by the owner or architect and are not included in the specification.

438. Location of Fixtures.—The proper heights from the floor for gas brackets or side-wall lights are from 5 feet 6 inches to 6 feet. Pendants should be placed from 6 feet 6 inches to 7 feet from the floor. The positions of the brackets should be carefully considered with regard to the swing of doors, registers, etc., and lights should be placed for sinks and to light properly the stairways, closets, etc.

439. Cutting for Piping.—All cutting should be done by the carpenter under the direction of the gas-fitter. The pipes should be run as near the ends of the spans of the joists as possible, where cutting is necessary, as cutting at these points weakens the joists less than at the centers of spans.

440. Testing.—When completed and capped, the gas-piping system should be tested by forcing compressed air into the piping by means of a hand pump; the pressure of the compressed air should be registered by a pressure gauge or a mercury column. The pressure indicated by the gauge should be from 7 to 10 pounds per square inch, and should be sustained for at least 1 hour. The mercury column should stand at a height of from 15 to 20 inches for a like period. The use of the mercury column is to be preferred, as the gauge is unreliable. In large buildings, it is customary to test the system in sections.

441. Leaks are located after the pressure is applied to the system by putting soap suds on the joints of the fittings. The bubbles formed by the escaping air will locate the leaks.

ELECTRIC WIRING

442. Ampere.—The **ampere** is the practical unit of electric current, or flow of electricity. The flow of electric current in amperes is analogous to the flow in a pipe in gallons per second.

443. Volt.—The volt is the practical unit of pressure, or electromotive force (abbreviated e. m. f.,) or difference of electric potential, which causes current to flow. Electromotive force, or difference of electric potential, is analogous to head in liquids. Electromotive force in volts may be compared to the head of a liquid, in feet.

444. Ohm.—The **ohm** is the practical unit of resistance to the flow of current, and is analogous to the resistance of the inner surface of a pipe to the flow of water.

445. Watt.—The **watt** is the practical unit of electric power. It is the product of 1 volt and 1 ampere and is sometimes called the **volt ampere.** It is equal to $\frac{1}{746}$ of a horsepower, so that 1 horsepower = 746 watts.

446. High and Low Potential.—A **low-potential** system is one on which the electromotive force is over 10 volts and less than 550 volts. A **high-potential system** is one on which the electromotive force is between 550 and 3,500 volts. An **extra-high-potential system** is one on which the electromotive force is over 3,500 volts. High-potential wires are seldom brought into buildings, and extra-high-potential wires never, except into power stations and substations.

447. Ohm's Law expresses the arithmetical relation between the ampere, volt, and ohm, as follows:

$$\text{amperes} = \frac{\text{volts}}{\text{ohms}};$$

or, the rate of flow of the current is equal to the electromotive force divided by the resistance.

448. Quantity of Current.—The quantity of electric current, or the number of amperes, used in a circuit depends on the number and size of lamps, fans, etc. supplied, on the efficiency of these various appliances, and on the electromotive force that causes the current to flow.

449. Rules of Wiring.—The rules laid down by the National Board of Fire Underwriters in their National Electrical Code are now followed by all the best electrical contractors, and the rules have been approved by The American Institute of Architects, The American Institute of Electrical Engineers, The American Society of Mechanical Engineers, The National Board of Fire Underwriters, and similar organizations. These rules should be made a part of all electrical specifications.

450. Approval of Wiring.—A certificate of approval may be obtained by the electrical contractor by having the authorized inspector of the Board of Underwriters look over the work. The contractor should be required by the specifications to obtain such a certificate of approval and to deliver the same to the owner on completion of the work, the acceptance of which should be made conditional on the delivery of this certificate.

Nearly all cities have a Department of Electricity, whose duty it is to pass upon the electrical work of every new building. When such a department exists, the specifications should provide that the contractor obtain the necessary permits before starting the work, and the certificate of approval on the completion of the work.

451. Laying-Out System.—The laying out of a wiring system should be so made that neither the cost of electric energy nor the cost of wiring will be excessive. The drawings should be made so as to show the location of all fixture outlets, switches, cut-out boxes, meters, main switches, etc., and should be supplementary to the specifications. All indications for wiring, outlets, switches, etc., should be made by means of the standard electrical symbols which may be found in almost any electrical handbook or catalog.

452. Methods of Wiring.—For the cheaper class of buildings, concealed knob and tube work is sufficiently good; but for the better grade of work, flexible armored conduit or rigid-iron conduit should be used. The rigid-iron conduit type is the only system adaptable to fireproof construction. For wiring of an old building, metal molding can be placed directly on the plaster or woodwork and afterwards painted. Flexible steel-armored conductors are frequently used in old buildings where the work must be concealed.

453. Knob and tube work should have wires of opposite polarity not less than 5 inches apart. The outlets should be formed with American circular loom or porcelain bushings thoroughly fastened in place. Knob and tube work may be used for low-tension current only. High-tension current should never be used in the buildings.

454. Armored Conduits.—Flexible steel-armored conduit consists of a spiral of metal strips, presenting convex surfaces inside and out. This is a very strong and flexible conduit, but it is not waterproof and should be used only where it will not be exposed to moisture. Flexible steel-armored conductors, generally known as *BX* work, consists of a pair of insulated copper wires twisted together and surrounded by a spiral metal casing.

455. Rigid Conduits.—Rigid conduit is mild steel pipe and is supplied with elbows, couplings, and other fittings. It is either enameled or galvanized; galvanized conduit is better than the enameled, as it possesses greater electrical conductivity, since is it much easier to ground through the galvanizing than through the enamel. Rigid conduit, if properiy lnstalled, is absolutely moisture-proof and waterproof.

Conduit should be fastened in place with hooks and pipe straps in a manner similar to gas piping. Neither rigid nor flexible conduit should be used in sizes smaller than $\frac{1}{2}$ inch inside diameter. Several wires can be run in the same conduit but main feeders and branches should each have separate conduits, and separate wiring systems should always be in separate conduits. Conduit is used for the double purpose of protecting the wires and of affording a convenient raceway for the installing and changing of wires.

456. Conduit Elbows.—The changes in direction of conduit work are made with bent conduits or by standard elbows. There should not be more than four elbows in any one run from the cut-out box to the switch or from the cut-out box to the outlets, in order that the *fishing* (pulling the wire through the conduit) may be easily done.

457. Finishing Conduit Work.—After the conduit is all in, the plastering may be done before the wires are fished, after which tests should be made to see that there are no grounds and that the insulation resistance is sufficiently high.

In conduit work, when wires have been fished, the openings about the wires should be plugged at outlets and made as moisture-tight as possible with tar paint or some other suitable compound.

458. Location of Wires and Conduits.—The wires and conduits in wooden buildings are run between the joists, and studding; on brick or stone walls, in chases or behind furring; and in fireproof construction, between floor arches and suspended ceiling, in chases of partitions, behind casings of columns, in shafts, and in wooden moldings, upon the surface of the plaster. In fireproof buildings, the main feeders are usually run in a shaft from which the branches are taken through cut-out cabinets at each floor.

459. Pull Boxes.—Long lines of conduit should have covered outlets, or what are called *pull boxes*, inserted at angles, junctions, and such other points as will facilitate pulling in the wires.

460. Outlet boxes for conduit work are of two types, one where the box is made for exposed work, with a given number of outlets, and the other for use where the wiring is concealed. In the latter type the sides are made with circular indentations which may be knocked out with a hammer to make an outlet at the desired point. Conduit should always be securely fastened to outlet boxes with locknuts and bushings. Boxes are made either enameled or galvanized.

461. Electric Connection.—A ground connection must be made permanently with the conduit, as it is difficult to prevent its partial grounding in any case. All parts of a conduit system should form one electric unit; that is, electric connection between conduit ends at junction boxes or cabinets should not be broken.

462. Wire.—Copper wire is used exclusively for electric conductors, because it has low resistance and is easily soldered when splicing. Small wires are made solid; large wires and cables are made of a number of strands of finer wire twisted together.

463. Wire Sizes.—The size of wires required depends on the quantity of current to be carried, the length of the wire, and the voltage at which the current is supplied. The proper size may be calculated or obtained from tables prepared for this purpose.

All wire larger than No. 10 Brown & Sharpe gauge should be stranded, as it would be too stiff as a single wire to handle easily. No wire smaller than No. 14 Brown & Sharpe should be used except in flexible cord and fixtures, on account of its resistance and liability to breakage.

464. Wire Resistance.—The amount of resistance of a wire varies directly as its length and inversely as its size; the larger the wire the less the resistance.

465. Specifying Wiring.—In specifying the drop in voltage, the permissible drop in voltage should not exceed 2 per cent. of the line voltage. The specification should always state whether the wiring should be for alternating or direct current and whether it should be on the three-wire or the two-wire system.

466. Making Joints in Wiring.—In making joints in electric conductors, the insulating covering on the portion of the wires to be jointed should be cut away and the wires scraped clean. They should then be twisted together until the joint is mechanically and electrically secure, after which it should be well soldered to preserve the connection and then covered with insulating compound and friction tape.

467. Wire Cables.—For large buildings where a heavy circuit is required, a lead-covered service cable is used. This cable is run underground in an iron pipe from the building to the company's pole, which it ascends to the main cables.

Feeders are run from the main switch to the various distributing cut-out cabinets from which the distribution circuits are run, to the lamps, etc. The feeders and the branches are all fused, so that if the current is raised above the safe carrying capacity of the branch, the fuses are melted, thus breaking the circuit. These fuses are called *cut-outs*.

468. Capacity of Branch Circuits.—Branch circuits depending on one fuse or cut-out should not carry more than 660 watts, the power required for 13 ordinary 50-watt lamps. A violation of this rule may render a building uninsurable.

469. Cut-Out Cabinets.—The distributing centers mentioned in Art. **467** are called *cut-out cabinets*. They are generally built of sheet steel not less than No. 12 gauge, either bent up and flanged, or reinforced with angle-iron frames and fitted with steel doors with concealed hinges and brass cylinder locks. In very cheap work they may be built of well-seasoned hardwood and lined with $\frac{1}{8}$-inch sheet asbestos and have paneled hardwood doors lined with $\frac{3}{8}$-inch asbestos wood.

Cabinets should be fitted with slate-panel boards $\frac{7}{8}$ inch thick, fitted with the necessary switches, fuse connections, and copper bus-bars. Boxes should be made enough larger than the panel board to allow at least 3 inches of gutter space around the panel, to accommodate wiring, and should have slate-gutter barriers made of $\frac{1}{2}$-inch slate. The frame of the door should cover gutter space. A number of types of dead front panels which give absolute safety in replacing fuses or throwing switches are now on the market. In cheap work where wood boxes are used, porcelain base cut-outs are used. Panels should be set flush with the face of plaster.

470. Fuses up to 30-ampere capacity for 110-volt current are usually of the plug or Edison base type. All fuses of greater capacity should be of the enclosed cartridge type. Fuses for branch circuits should not be more than 10 amperes capacity.

471. Switches.—The switches that control the lights in a room should always be of the flush type. There are a number of different types of flush switches on the market, the most popular being the two-button and single-button push type, and the toggle switch. Where there are several switches controlling the lights in one room, they are generally grouped in one box with a single plate which is called a *gang plate*, to cover them all. All face plates should be finished to match the hardware in the room. Switches having luminous buttons and toggles are now made by a number of manufacturers.

472. Receptacles.—Where temporary current may be required for reading lamps, fans, etc., receptacles, or connecting plugs, are placed in the floor or baseboard. Connection to the fixtures from these receptacles is made by means of flexible cord.

473. Specifying Switches and Receptacles.—The make and type of all switches, wall, and floor receptacles should be specified. Where special switches, such as three-way and four-way switches, which control groups of lights by means of two or three switches located at different points, electrolier switches which control several lights from one switch, or automatic door switches for closets, are to be used, the location of the switches and the lights which they control should be specified.

474. Electric Meters.—The meter or meters for large buildings are usually placed on a panel in a separate closet or room, where they will be accessible to no one except the janitor or other authorized person. Every precaution should be taken to avoid fire resulting from melting fuses.

For residences of ordinary size, the meter and main switch are usually placed in the attic, and are enclosed in a panel box fitted with a door, which should be kept locked.

Electric-light companies usually furnish and erect their meters on panel boards provided for that purpose.

475. Transformers are usually placed on the poles at the end of the lead service cable from the building, and serve to transform the high-

TABLE V

CURRENT REQUIRED FOR ELECTRIC LIGHTS

Lamp Wattage	110-Volt Current Ampere	220-Volt Current Ampere
25	.22	.11
50	.45	.23
75	.70	.35
100	.90	.45

potential current of the mains, or pole line, to a low-potential current suitable for use in the building.

476. Methods of Fastening Fixtures.—Suitable means of support should be provided for the fixtures. If combination fixtures are used, the gas outlets when properly fastened will do; but, if the work is straight electric conduit work, a threaded stud fastened to the bottom of the outlet box should be used. Wrought-iron threaded **T**'s fastened to cleats are used for knob-and-tube work and molded work.

477. Electrical Appliances.—A great number of electrical appliances are at the disposal of the architect, and quite a number should be included in the specification; among these are bells and buzzers, burglar alarms, intercommunicating telephones, door openers, clocks controlled by master

clocks, signaling systems, pumps, fans, motors for operating all types of machinery, heaters and cooking ranges.

478. Wattage for Lights.—Table V gives the approximate number of amperes of current required for the wattage for incandescent lamps with currents of 110 volts or 220 volts.

HEATING

STEAM AND HOT-WATER HEATING

479. One- and Two-Pipe Systems.—Gravity-return steam-heating systems may be piped either as one- or two-pipe systems. For moderate sized buildings, one pipe systems, if properly installed, work satisfactorily.

480. Exhaust- and Vacuum-Steam Systems.—Vacuum steam-heating systems using either exhaust steam for power plants or steam from low pressure boilers are now used to quite a considerable extent. In this method of heating, the water of condensation and the air are removed from the system by means of a pump on the end of the main return line. On account of this feature all air valves are omitted from the radiators, and special return valves which allow the removal of water and air and prevent steam from entering the returns are used. If exhaust steam is used, a back-pressure valve should be installed on the exhaust line, so that when the quantity of steam coming from the engine becomes too great, the excess pressure will permit it to escape into the atmosphere. On account of using exhaust steam, or steam at a very low pressure, these systems are quite economical in their operation.

481. Central-Station Steam Supply Systems.—When steam is supplied from an outside or central station, as is done in many cities and towns, or where the boilers are in separate buildings, as in public institutions, the steam is delivered by an underground main through the cellar wall. This service pipe is supplied with a shut-off valve, a pressure-reducing valve, and a pressure gauge. As a rule, the water of condensation is delivered into the sewer; but before this is done it should be cooled, after passing through a steam trap, by running it through a cooling coil of proper size. This cooling coil is usually a coil of indirect radiation.

In public institutions where the central station is near by or at a lower level, the water of condensation may be either pumped to the central station or allowed to flow back to the boilers.

482. Hot-Water Systems.—The boiler used for hot-water heating should have ample capacity, in order that a more uniform temperature may be maintained. The piping should be a two-pipe system, with the

supply pipes sloping upwards toward the inlet at the top of the radiator. The return pipe should leave the bottom of the radiator, and should slope downwards to the bottom of the boiler. To avoid friction, which would retard the flow of water in the system, gate or quick-opening valves should be used, and the valves should be arranged to pass a small quantity of water at all times, in order to avoid freezing when the valve is closed. An expansion tank should be placed at the highest point of the system, and should be of capacity ample to insure that all the radiators are filled at all times. Provision should be made for filling the system when required.

483. Comparison of Systems.—About 25 per cent. more radiator surface is required for a hot-water or a vacuum-direct system than would be necessary for an ordinary direct-steam installation to heat the same space.

About 7 per cent. more radiator surface is required for a vapor-vacuum direct system than would be required for a gravity-return direct-steam installation to heat the same space, and about 60 per cent. more radiator surface is required for hot-water direct systems.

484. Boilers.—Steam and hot-water boilers are made in many varieties, both of cast iron and steel, and either if well made will give good service. Cast-iron boilers are made in sections, the size and number of which determine the boiler capacity. Boiler catalogs give the number of sections for each boiler, the length, width, and height, the size of the grate, the capacity of the firebox, the size of the steam and return-main outlets, and the amount of radiation that it is supposed to supply. Steel boilers are either of the tubular fire-box pattern or the regular tubular return boiler; the former type are most generally used.

Boilers are made to burn anthracite coal, bituminous coal, coke, gas, or oil.

The selection of the type of boiler should be made with great care. If possible, different makes of the more reputable boilers in actual use should be looked over and their efficiency thoroughly investigated. As all the best makes of steel boilers are made according to the code of the American Society of Mechanical Engineers, is always safe in selecting a boiler bearing the society's label.

485. Boiler Capacity.—The radiation capacity of cast-iron boilers varies from 200 square feet for steam and 375 square feet for hot water to over 12,000 square feet for steam and over 18,000 square feet for hot water. Steel boilers run from 900 square feet for steam and 1,500 square feet for hot water to 14,000 square feet for steam and 23,000 square feet for hot water. A small, vertical, round hot-water heater is made with a capacity of 200 sq. ft. to 800 sq. ft.

The ordinary residence requires from 300 to 800 square feet of steam radiation and about 60 per cent. more for hot water.

486. Boiler Setting and Covering.—The boiler should be set on a concrete foundation, and the outer surface of it should be covered with an

asbestos cement to the thickness of 1 inch. This cement is applied in three coats while the heater is under fire. The final coat should be rubbed smooth with a piece of wet rubber, after which the entire surface is covered with 6-ounce canvas put on with good flour paste.

487. Cutting for Steam Fitting.—The carpenter and the mason should do all necessary cutting for the steam fitter, and a clause to this effect should be in both the heating and the general specifications.

488. Piping.—The pipes of a steam or hot-water system should be run in such a manner that the supply of steam or water will be evenly distributed to all parts of the building. When the piping is completed and tested, the distribution should be carefully noted, and if it is necessary to run an extra feeder to any point, it should be done. This extra piping should be provided for in the specification. Care should be taken to have piping large enough and properly pitched.

489. Pipe Defects.—It is important that the full area of the pipes be obtained, and for this reason all pipe should be cleared of burrs, dirt, scale, etc.

490. Supply Pipes.—The supply pipes to the hot-water radiators on the upper floors, where a two-pipe system is used throughout, may be smaller than the pipes for the same-sized radiators on the first, or lower, floor; because the higher the radiator, the greater will be the pulling force of the return circulation.

491. Risers.—The supply risers to the different radiators, both for steam and hot water, should be taken from the top of the main. The returns of the hot-water radiators should connect into the side or the bottom of the main, while the steam returns should connect into the top.

492. Branches.—Branches leaving the steam main at an angle should have a pitch of 45°, and should be of one size larger pipe than the riser, using reducing fittings for connections.

493. Future Extensions.—Where additions to the system may be required at some future time, the piping should be proportioned accordingly, and plugged T's placed where the future branches may be needed.

494. Drip Pipes.—Where water is liable to accumulate in the steam mains, drip pipes should be taken off and connected to the return. This will relieve the system of water that would otherwise interfere with the circulation of the steam. These drips should be taken off the bottom of the main.

495. Supports.—Expansion and contraction of hot-water and steam-pipe lines should be provided for by using proper expansion hangers and supports for both the piping and the radiators.

496. Fittings.—Long-turn fittings should be used in hot-water systems, as they greatly aid the circulation.

497. Unions.—The common screw union should never be used in hot-water piping; the right-and-left coupling should always be employed instead. Flanged unions should be employed for large pipes.

498. Valves.—Gate valves should be used in a hot-water system and in all horizontal lines in a steam system, as they offer less resistance to the circulation of water than globe valves. Gate valves should be placed on branch supplies and returns so as to control each radiator or group of radiators separately. This arrangement allows repairs to be made on the radiator or radiator valves without turning off the steam from the entire system. These gate valves should be labeled so as to indicate which lines they control.

Valves larger than $2\frac{1}{2}$ inches should have iron bodies and brass mountings and smaller valves should be of brass throughout. For radiators a number of types of special valves are now made and among them is one which can be opened by giving it but a half turn, which can easily be accomplished by touching it with the foot; modulating valves for either steam or hot water are made so that by setting the indicator on the dial of the valve the temperature of the radiator may be regulated by throttling the inlet on the radiator.

Stop-valves should never be placed on the line between the boiler and the expansion tank of a hot-water system; also the tank should be protected against freezing.

To prevent freezing of water in the radiators in a hot-water system when the valves are closed, it is a common practice to have a small hole drilled through the valves so that a small circulation of water may be maintained at all times.

499. Vents.—Air vents should be placed on the return lines in the two-pipe steam system, so as to get rid of any air that may accumulate. Vents should also be placed on the hot-water system at the proper points.

500. Radiator Connections.—Hot-water radiators cannot be successfully operated with a single connection, but should always have two connections, one for the supply and one for the return. For the best results, the supply should enter at the top of the radiator and the return should always connect at the bottom.

501. Radiation.—In buildings heated by steam or hot-water systems, the term *radiation* is used to designate the surfaces used for heating purposes, and these may be either direct, indirect, or direct indirect. The amount of radiation is governed by the number of sections in each radiator, the number of coils in each section and the height of the radiator. Radiators are made in a number of styles and in several forms for special uses.

Except in vacuum systems, each radiator should be supplied with a nickel-plated air valve which will allow the air to escape, but which will close when the steam reaches it. The better types of air valves are fitted with drip pipes, which carry any water, which may come through them, back into the radiator. All valves which control the supply and return pipes should have polished hardwood handles to protect the hands from the heat.

In bathrooms, narrow hallways, where space is valuable and in basements where the radiators must be placed high enough to give flow for the condensation back to the boiler, wall radiators should be used.

Dining-room radiators are made with a cupboard in the center with sections on either side. This cupboard is intended to be used for keeping dishes and food warm.

As a general rule, radiators should be placed on outside walls, under or near exposed windows or near exterior doors where they will warm the cold air that may enter through the cracks. If radiators are placed under windows the top of radiator should never be higher than the stool of the window.

The ordinary type of radiator can generally be used for either hot water and steam, except that for hot-water and vacuum-steam systems, hot-water radiators, that is those having the inlet at the top, should be used. A careful investigation should be made before specifying any particular type or kind.

The specifications should give a list of the different radiators, with the amount of heating surface and the height in each case. It should also state the style and the number of sections.

502. Direct Radiation.—In direct radiation the air in a room is heated by a radiator placed in the room. The different forms of direct radiation may be classed as ordinary, window, wall, corner, dining-room, and built-up pipe or coil radiation.

503. Indirect Radiation.—The radiators for indirect radiation are usually placed in the basement, and are encased in galvanized-iron boxes, which are connected to the outside atmosphere and to the registers by ducts also made of galvanized iron. By this arrangement, the rooms are supplied with heated fresh air. Indirect radiation is more expensive than direct radiation, but is considered more healthful.

Where indirect radiation is employed, about 50 per cent. more radiation surface is required than would be needed for the same number of rooms heated with direct radiation. This is due to the loss of heat from the ducts during transmission from the galvanized-iron radiator boxes to the registers, as fresh air is constantly being delivered from the outside, while in the direct method the radiator simply heats the air of the room.

Indirect radiation alone or in combination with direct radiation may be used throughout a building; for example, direct radiation is frequently

used on the second floor and indirect throughout the first floor, or the indirect may be used only for the best rooms on the first floor, the balance being direct. Indirect on the first floor and direct on floors above makes a very satisfactory arrangement.

As many indirect stacks as possible should be placed on the north side of the building. The radiators should be supported by an iron pipe suspended from the ceiling by iron rods.

504. Direct-Indirect Radiation.—The radiator used for direct-indirect radiation is placed in a manner similar to those used in direct radiation, but has a specially constructed base, which is enclosed, and connected by a small duct to a register in the outside of the wall. It also has a register in the base, which opens into the room. When the inner register is closed, the outer one is open, allowing fresh air to enter and pass up between the sections of the radiator, thus making it an indirect type of radiator. When the inner valve is open the outer one is closed, and the radiator becomes direct.

About 25 per cent. more radiating surface is required for direct-indirect radiation than for direct radiation, where it is used as indirect.

505. Plate-warming cupboards are often placed in the butler's pantry or elsewhere, and are a great convenience to the housewife. They consist of a cupboard lined with tin, copper, or galvanized iron, and have shelves made of coils on which perforated sheets of galvanized iron are placed.

506. Thermostats.—A *thermostat* is best defined as a mechanical thermometer operated either electrically or pneumatically to control either the drafts on the heater or the dampers in an indirect system, thus controlling the temperature of system. The thermostats operate either by the expansion of a fluid having a low boiling point or by an expansion member which is composed of two strips of metal having different coefficients of expansion, which are riveted or welded together. Where the steam is supplied from a central station or from a main in the street, the thermostat may control a mechanism which will open or close a valve in the main. Some types of thermostats are provided with a clock attachment which will raise the temperature at any predetermined hour.

507. Repairing Leaks.—As soon as the work of installing a heating system is completed, steam or water, as the case may be, should be turned into it, and if any leaks are discovered, they should be repaired immediately. The contractor should be required by the specifications to agree to make repairs free of charge for one winter following the completion of the system, where such repairs are necessitated by defective workmanship or material.

508. Temporary heat for drying plaster, etc., is often necessary before the building is completed, and the specifications should state plainly whether it is to be furnished by the contractor or by the owner.

HOT-AIR HEATING

509. Furnaces.—A great number of furnaces are now on the market, and the architect should thoroughly investigate the different makes and obtain the opinions of persons actually using them before deciding on any particular one.

Table VI gives the relations that should exist between the glass surface, volume of air to be heated, etc., and should be of great assistance in selecting a proper type and size of furnace.

510. Location of Furnace.—The furnace should be located toward the north and west sides of the cellar or in the center, and should be handy to the coal bin. If necessary, in order to get sufficient pitch to the leaders, the furnace should be sunk into a pit.

511. Air Inlet for Furnace.—The fresh-air inlet should be made of galvanized iron, and should have a valve or damper by which the supply

TABLE VI

FURNACE DATA

Glass Surface and Equivalent Square Feet	Volume of Air to be Heated Per Hour Cubic Feet	Space to be Warmed Cubic Feet	Furnace Heating Surface Square Feet	Grate Area Square Inches	Smoke-Pipe Diameter Inches
125	10,000	2,500	53	106	6
150	12,000	3,000	62	124	6
200	16,000	4,000	85	170	7
250	20,000	5,000	106	212	7
500	40,000	10,000	212	424	8
750	60,000	15,000	320	640	9
1,000	84,000	21,000	425	850	10

of cold air may be controlled. The opening to the outer air should be on the north or the west side of the building, and should be protected from animals, etc., by a screened sash. The area of the duct should be from two-thirds to three-fourths of the sum of the areas of all the leaders.

512. Smoke Pipe.—The smoke-pipe connection should be as short and direct as possible, and the area of the smoke flue should be of the size indicated in Table VI, or larger. If rectangular, a flue of larger area is required than if round.

513. Hot-Air Pipes.—The hot-air pipes for the ordinary residence from the furnace to the registers should be proportioned according to the

size, exposure, outside glass, and wall area of the rooms they are to supply. The leaders, or pipes, in the cellar should be larger in area than the stacks that they supply and should have a good rise from the furnace to the stacks. The leaders are from 7- to 12-inch round pipe, according to necessity, and the stacks are about $3\frac{1}{2}$ inches by the width necessary. If $2'' \times 6''$ studding is used, the stacks may be widened with good results. The stacks should be covered with asbestos paper, and a great saving in radiation is obtained by also covering the leaders with asbestos paper or felt. Leaders and stacks are usually made of IC or IX bright tin.

514. Double Stacks.—Patented double hot-air stacks that save considerable heat and eliminate the use of asbestos covering are now on the market. These stacks consist of an outer and an inner pipe, and are made in 2-foot lengths. A full line of fittings is also supplied.

515. Dampers.—Each leader should be provided with a damper near the place where it joins the furnace, and it should be tagged at this point to indicate the room to which the pipe leads.

516. Rules for Finding Sizes of Leaders and Stacks.—The following rules will be found valuable in determining the proper sizes for leaders and stacks:

Rule I.—*To find the area of the leader pipe required for the first floor, add together the area of the exposed glass surface, in square feet, the area of the exposed wall surface, in square feet, divided by 10, and the volume of the room, in cubic feet, divided by 100; the sum will be the area of the pipe, in square inches.*

Rule II.—*To find the area of the leader pipe required for the second floor, proceed the same as in rule I, and multiply the sum found by .8.*

Rule III.—*To find the area of the leader pipe required for the third floor, proceed as in rule I, and multiply the sum found by .6.*

For a north or a west exposure, increase the leader-pipe area 10 per cent.

The stacks to the first-floor registers should be of the same size as the leaders. The stacks for the second floor may have .8 of the area of the leader pipe, and stacks for the third floor, .6 or .7. Stacks should have their sectional area increased 10 per cent. for each offset.

517. Registers.—On account of the grille-work and the shutters, the effective register opening should be calculated at about two-thirds of that given in the manufacturer's catalog. The effective area of the register should equal or exceed slightly the sectional area of the stack. The registers may be specified by number, size, and style from the manufacturer's catalog.

518. Heat Circulation.—The circulation of heat through some branches of a furnace system is often defective and difficult to remedy, but is generally

due to reduced suction at the register end of the pipes. This trouble may be remedied by running the ventilating flues from such rooms to a main duct in the attic, through the roof, or into an unused flue in the chimney; or a fireplace or opening into an unused chimney flue will supply the necessary suction. A vent pipe should not be run back to the fresh-air inlet as is sometimes done, as this mixes the foul air taken from the room with the fresh supply.

519. Ventilation and Heating Plans.—Plans of each floor and basement should be made that show the location of the radiators, direct and indirect, and the registers; the direction and sizes of the steam or hot-water piping and the galvanized-iron ducts; and the position of the fans, heaters, etc. These plans should supplement the specifications.

VENTILATION

520. Ventilating Systems.—The ventilation of the ordinary residence is sufficiently taken care of by fireplaces and cracks at doors and windows, but for schoolhouses, asylums, and buildings where many persons are in the rooms and the consumption of oxygen is large, some method of artificial ventilation is needed. The usual methods may be classed under the *vacuum* and the *plenum systems* or combinations of these two.

521. Vacuum System.—In the vacuum method the air is exhausted from the different rooms by means of a fan or heated air column, thus causing a suction and making room for the entering heated air.

522. Plenum System.—The plenum method is usually combined with the heating system, the air being forced over heating coils and into ducts leading to the various rooms, thus displacing the foul air, which is either drawn out by a fan, a heated air column, or by the natural rising of the hot air, as in theaters and lecture halls where the air escapes at the center of the ceiling. In theaters, the rise of the air is often assisted by a group of lights in the central chandelier.

523. Amount of Air Needed.—Table VII gives the amount of fresh heated air considered necessary for each occupant per hour in different classes of buildings.

524. Vents.—Vent registers at the floor should be low and wide. If ceiling vents are used, they should never be placed directly over the hot-air register, as it will cause the hot air to short-circuit and thus leave the balance of the room unsupplied. In this case, the vent and hot-air registers should be on opposite sides of the room. Placing vent registers at both the floor and the ceiling of a room and on the side opposite the hot-air registers is a good arrangement, as it gives ventilation to both the upper and the lower parts of the room.

525. Schoolhouse Ventilation.—Schoolhouses heated by an indirect plenum system should have a certain amount of direct radiation to take care of the rooms when the fan is stopped; but, if possible, the ventilation should be so arranged that when the fan is not in use, suction will be furnished by natural ventilation to make the rooms reasonably warm without the use of the direct radiation.

Schoolrooms should contain from 200 to 260 cubic feet of air space for each scholar, the ceiling being from 12 to 14 feet high.

526. Air Washers.—In connection with ventilation systems, air washers are frequently used for the purpose of humidifying the air and removing all dust, soot, etc., from the air. They are always used with a plenum system of ventilation. The air, after passing over the tempering

TABLE VII

AMOUNT OF FRESH AIR REQUIRED IN DIFFERENT BUILDINGS PER OCCUPANT

Class of Building	Cubic Feet Per Hour Per Occupant	Cubic Feet Per Minute Per Occupant
Hospitals	4,000 to 8,000	66 to 100
Court rooms	2,000	33
Legislative halls	2,000	33
Theaters	1,500 to 1,800	25 to 30
Halls	1,000 to 1,200	17 to 20
Churches	1,000 to 1,200	17 to 20
Schools	1,800 to 2,400	30 to 40

coils, enters the spray chamber in which are a number of spray nozzles which give a body of atomized water through which the tempered air passes, is humidified and cleaned, and then reheated by means of pipe coils placed at the discharge end of washers.

527. Garbage incinerators are installed in residences and apartments for the destruction of household waste. They are made in two types: the built-in-the-chimney incinerators, which use coal or wood as a fuel, the garbage being dropped down the flue from a hopper located in the kitchen above, and the gas incinerator which is made in portable and built-in models. These incinerators are located in the kitchen, using gas as a fuel. Large-type incinerators are used for waste destruction in hospitals, etc., and are a necessary part of the equipment. Garbage-burning water heaters are noted in Art. **421.**